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THE CAPULIN
THE CATLIN MARK
MENDELISM IN FUR SHEEP
EUGENICS AND HUMAN MORALITY
RELATIONS OF CYTOLOGY AND GENETICS
THE GERMINATION OF BARLEY SEEDS
FINE STREAKED MAIZE LEAVES
THE SCIENCE OF EUGENICS
RYE AND WHEAT HYBRIDS

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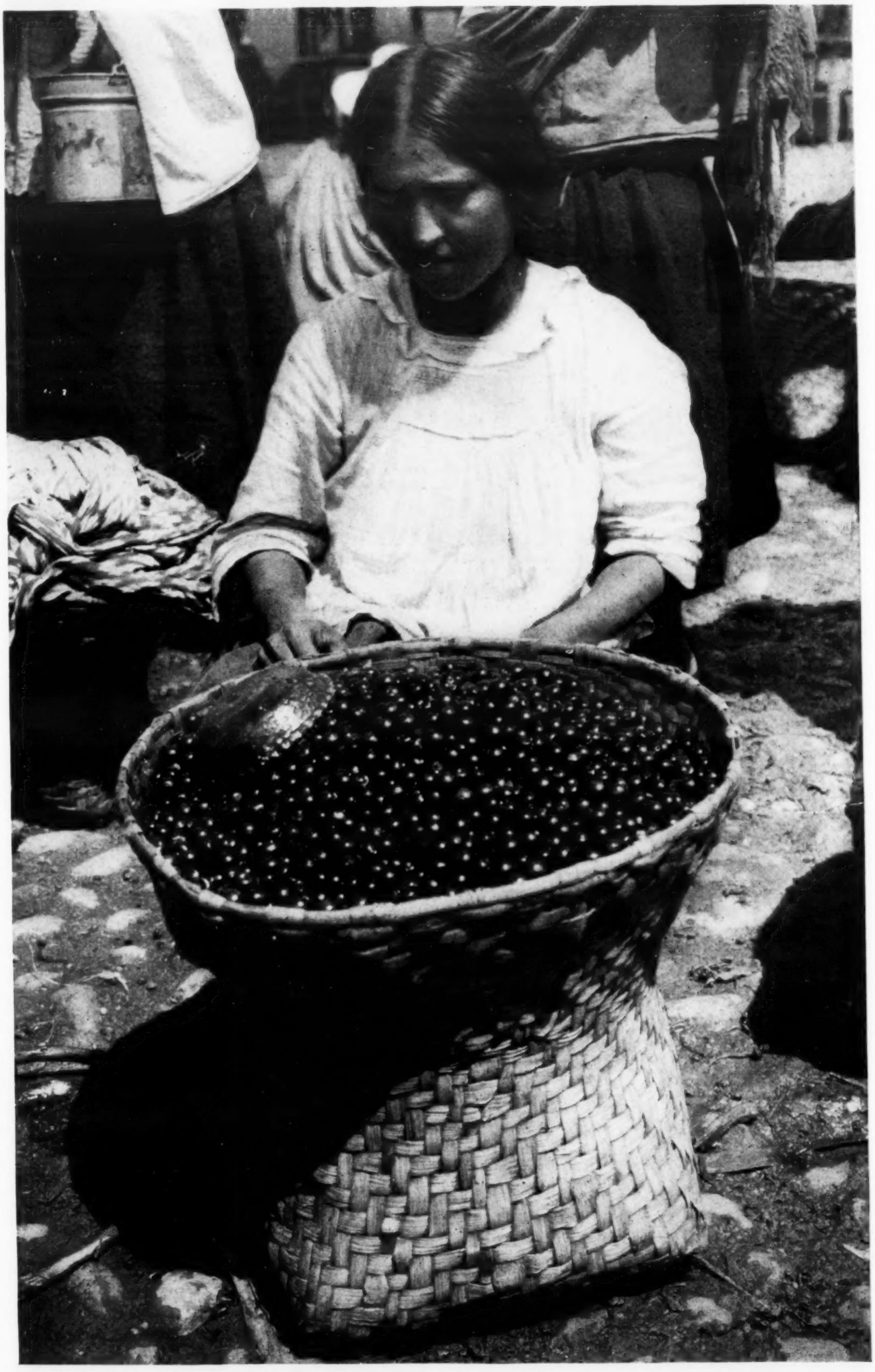


CAPULINS ON SALE IN AN ECUADOREAN MARKET-PLACE

In every town and village of the Ecuadorean highlands huge baskets of capulíns are a daily sight in the market-place during at least three or four months of the year. The capulín is, in fact, the most important fruit of that region, judged either from the standpoint of production, or as a factor in the diet of the Indians who constitute at least three-fourths of the population. (Frontispiece.)

THE CAPULÍN CHERRY

A Superior Form of the Northern Black Cherry Developed in the Highlands of Tropical America

WILSON POPENOE
Agricultural Explorer, United States Department of Agriculture
AND
ABELARDO PACHANO
Quinta Normal de Agricultura, Ambato, Ecuador

THE improvement of our native fruits was begun shortly after the colonization of North America by Europeans. At first conducted in a somewhat haphazard manner, more recently in a very systematic way, the total result has been the production of many excellent varieties and hybrids, of which notable examples are to be found among the grapes, plums, and strawberries.

Our horticulturists, however, seem to have overlooked the wild black cherry, *Prunus serotina* Ehrh. Not so the aboriginal inhabitants of Mexico and certain other parts of tropical America, who have, on a number of high plateaus, cultivated this tree for centuries. They have so changed the character of its fruit that horticulturists familiar with it in the United States would scarcely recognize the capulín of Ecuador as belonging to the same species. Botanists, even, have considered it as distinct until very recent years, when closer study has served to show that it differs only in those characters which may be changed by cultivation. Its fruit, instead of being small, bitter, and having very scanty flesh, is sometimes the size of a Bigarreau cherry and much resembles the latter in flavor, except that there is usually a trace of bitterness in the skin. This characteristic, in the best varieties, is not so pronounced as to be objectionable.

The capulín is therefore a fruit worthy of serious attention in the United States as well as in other countries. It can be cultivated in many regions where European cherries are not successful, and it is tremendously productive. By means of vegetative propagation, which has never been practiced in tropical America (with the exception of a few sporadic instances in very recent years) it will be possible to establish as horticultural varieties the best seedling forms which have been developed, and perhaps to bring about further improvement. For it must be remembered that the process which has been employed in tropical America has been one of semiconscious selection, and that when a superior seedling appeared there was no means of perpetuating its good qualities. Improvement has therefore been slow, and has come about through raising the level of the whole species, instead of through repeated selection of superior individuals, followed by vegetative propagation.

HISTORY AND DISTRIBUTION

As an indigenous species, *Prunus serotina* is distributed from Nova Scotia westward to the northern shore of Lake Superior, thence southward to Florida, thence Northwestward to the Dakotas, eastern Nebraska and Kansas, thence through western Texas, southern New Mexico and Arizona into Mexico and probably Central America. It has generally been considered to be indigenous as far south as Colombia and Peru, but we are of the opinion that it has become naturalized in those countries in comparatively recent times. Father Bernabé Cobo, in his "Historia del Nuevo Mundo," one of the classic works on the natural history of the Spanish colonies in the New World, wrote in 1653: "This tree

occurs in cool regions, such as that of the Valley of Mexico, and it grows in this city of Lima (Peru), where it was brought, a few years ago, from New Spain (Mexico)." The historian Gonzales Suarez asserts (though without saying upon what grounds) that the plant was worshipped by the inhabitants of Cañar province, in southern Ecuador, before the arrival of the Spaniards. Modern authors usually base their belief in the indigenous character of this species throughout the Andean region upon the fact that it occurs there, at the present day, in a thoroughly naturalized condition.

At the time of the Conquest, the capulín was an important fruit-tree in central Mexico. It appears at least twice in the picture-writings which record the names and tribute required of towns conquered by the Aztec nation. From this and other evidence there can be no doubt that the name capulín (modified to capulí in South America), by which the tree is today known from Mexico to Peru, is of Mexican origin. Various derivatives of the word are found in dictionaries of the Nahuatl or Aztec language: Molina[1] gives *capulla* and *capulquauhtla* (*capulín* plus *quauhtla*, grove) as terms used to express a capulín orchard or grove; *capulquauitl* (*capulín* plus *quauitl*, tree), a capulín tree; and *capuloctli* (*capulín* plus *octli*, wine), a species of wine made from the fruit.

Probably the earliest detailed account of the capulín is that written by Francisco Hernandez, *protomedico* of the King of Spain, who was sent to Mexico to make a study of the useful and medicinal plants of that country. He devoted five years to the task, which was completed in 1575, and then returned to Spain, taking with him extensive manuscripts, of which copies were left in Mexico. The friar Francisco Ximenez published, in 1615, an annotated translation of these (the Latin original of Hernandez was not published until 1651), from which we reproduce below, in English, the chapter on the capulín. We have attempted to preserve the picturesque phraseology of the period in which the account was written, including the reference to the "hot" and "dry" nature of the fruit,—terms which were believed to indicate the effect which the substance under consideration had upon the human body, if consumed in quantity, and which were proper to the classification of drugs and foodstuffs used at that time by the Spaniards:

Chapter LXXI. Concerning the tree called Capulín, which bears the cherries of the Indies.

The capulín is a tree of moderate size, which has leaves like our almond or cherry, finely serrate, and pendent racemes of flowers, which develop into fruits altogether like our cherries in size, color, form, and in the seeds or stones, and which taste somewhat like blackberries, for which reason I think this tree must be classified among the species of cherries not known in the Old World, although some people think that it may be considered a kind of Metzi;[2] the fruit is a trifle acid and astringent, although when fully ripe it becomes sweet and loses much of its sourness and austerity and is pleasant to the taste, so much so, in fact, that many people who are competent to voice an opinion in such matters consider it by no means inferior to our cherries; it is hot and moderately dry in nature, with some astringency; they make of this fruit bread and wine, when there is lack of these substances, but it is melancholy nourishment, and in certain manner injurious to the heart; it imparts a bad color[3] to the teeth of those who eat it often, but this is easily avoided if a little care is given to cleaning the teeth; finally, there is no lack of persons who esteem this fruit above all others which ripen in the summer time,—milady epicure, though not usually satisfied with any but the fruits of Spain, sometimes chooses it in preference to the latter. It flowers in springtime, and yields ripe fruit almost throughout the summer; it grows in cool climates like that of Mexico City, where it is found in orchards and fields, and is sometimes given cultural attention, sometimes not. An infusion of the bark, left to stand in the sun for fifteen days, and taken in doses of one ounce, cures dysentery; reduced to powder, the bark removes films from the eyes and clarifies the vision; it cures inflammations, and softens and moistens the tongue when it is dry from fever, which latter effect is secured also by using the juice of the young shoots.

The capulín does not grow upon the coastal lowlands of Mexico, since it

[1] Vocabulario de la Lengua Mexicana, 1571 (Facsimile edition, published at Leipzig, 1880).
[2] *Ziziphus lotus* Lamk.
[3] The Latin original of Hernandez says "black color."

THE SWEET CHERRY OF THE INDIES

The "Capulín, seu Ceraso dulci Indica," (Capulín, or sweet cherry of the Indies) as figured in the work of Francisco Hernandez, written about 1575, and published in 1651. Hernandez praised the tree highly, both for its medicinal virtues and for its edible fruits; many people competent to voice an opinion on such matters, he says, considered the latter by no means inferior to the cherries of Spain. (Fig. 1.)

AN AZTEC HIEROGLYPH

The name *Capulapan* (a town in Mexico) as it was expressed in the picture writing of the Aztecs. The word is composed of two elements (above) a capulín tree, and (below) a canal (*apantli*) filled with water. The latter element gives the termination *apan*. The name may have been given to a place where there were capulín trees and water, or the picture may have been an attempt to represent phonetically the name *Calpulapan*. The trunk of the highly conventionalized tree was painted in brown, the leaves at the ends of the three branches green, and the clusters of fruits bright red. (Fig. 2.)

demands a cool, subtropical climate, such as that found at elevations between 4,000 and 10,000 feet. It is abundant, at the present day, in and about the Valley of Mexico, and the fruit is often sold in the markets of the City. Throughout the country it is known, so far as we have been able to ascertain, under the Aztec or Nahuatl name capulín; but it is reasonable to believe that there are distinct names for it in some of the other indigenous languages of Mexico.

In Guatemala the tree occurs, as in Mexico, throughout the highlands generally,—sometimes as a semi-cultivated plant, sometimes as a wild species, or at least having the appearance of one. Its zone of cultivation in this country lies between 4,000 and 9,000 feet, and most of the trees are found in the region known as Los Altos, between Guatemala City and Quezaltenango. The Kiché Indians who live near the latter city know the fruit as *tup*, and distinguish two varieties, the *ek-i-tup* (red tup) and the *sak-i-tup* (white tup), the latter having fruits of much lighter color than the former. The presence of a name for this fruit in the Kiché language argues an ancient cultivation in the Guatemalan highlands.

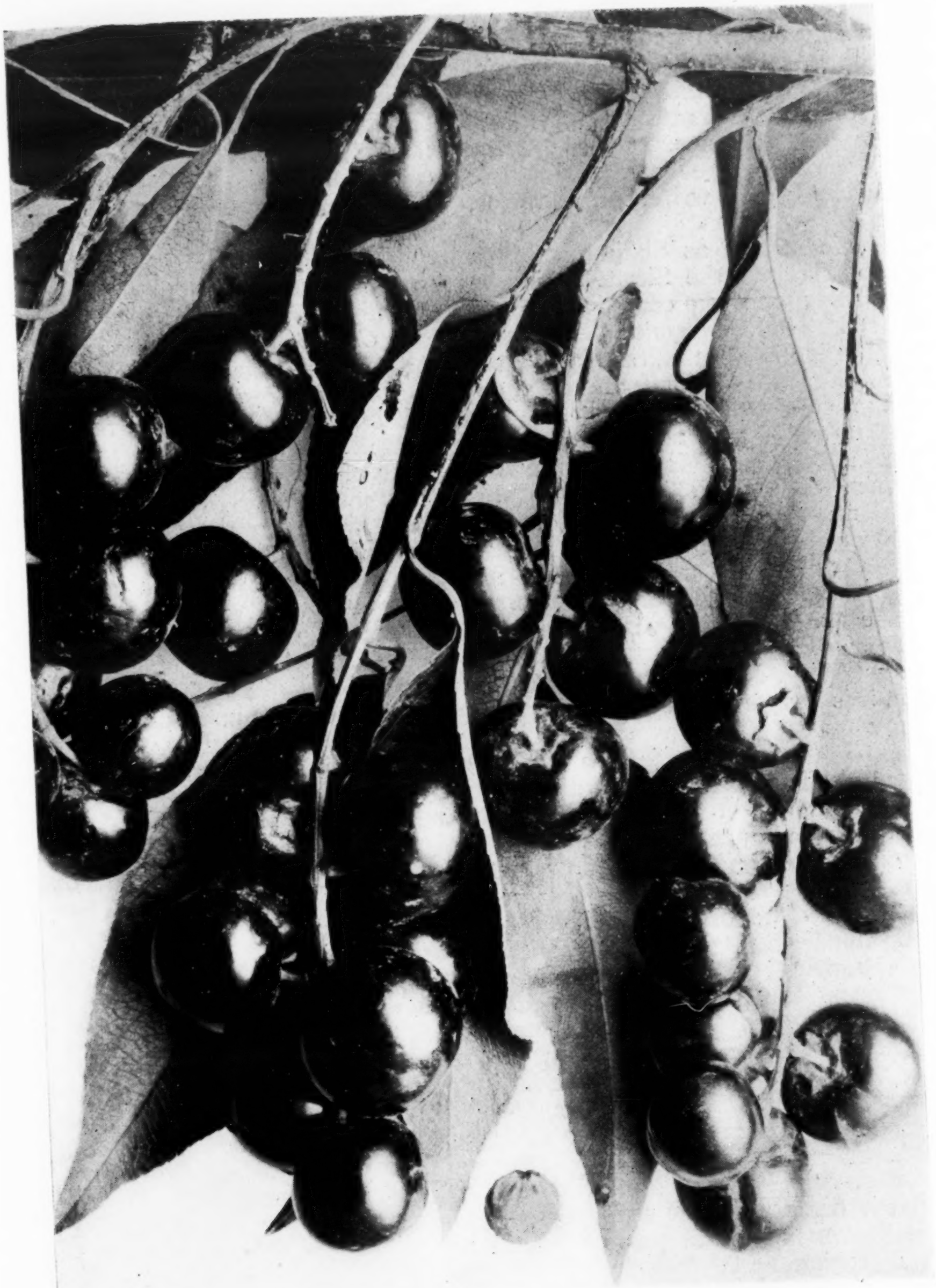
THE FAMOUS GONZALES CAPULIN TREE NEAR AMBATO, ECUADOR

This is one of the largest capulín trees in the Ecuadorean highlands, and at the same time one of the best, both in regard to productiveness and quality of fruit. It stands in the valley of the Rio Patate at Catiglata, a suburb of Ambato; the elevation of this region is about 8500 feet, and the climate is cool and dry. Its enormous crop matures during the first three months of the year: Figure 4 shows some of the fruits. Unless on very deep and fertile soil, capulín trees do not usually grow to more than half this size. (Fig. 3.)

Strangely enough, the capulín is practically unknown in Costa Rica, though abundant both north and south of that republic. Pittier does not mention it in his "Plantas Usuales de Costa Rica," nor were any trees seen during a three months' survey of Costa Rican fruits made by one of the present writers in 1920.

In the highlands of Colombia the tree is again found abundantly, and here as elsewhere in South America it is known under the Nahuatl name capulín, modified to capulí. The Spanish name *cerezo* (cherry tree; the fruit, *cereza*) is sometimes applied to it, both in Colombia and Guatemala; but most people recognize capulín as the correct appellation. Upon the broad plain surrounding Bogotá (the sabana, as it is locally called) there are many capulín trees, and the fruit is frequently seen in the markets of the capital. The elevation of this region is about 8,500 feet. The tree also grows upon the mountain sides between Bogotá and the Magdalena valley, down to elevations of about 5,000 feet; and we are assured that it is known elsewhere in Colombia.

Nowhere in the last-named republic, however, is the capulín so important



AN IMPROVED CAPULÍN FROM THE ECUADOREAN ANDES

These fruits from the Gonzales tree at Catiglata, near Ambato, shown natural size, represent the highest horticultural development of the capulín. They are dark purplish maroon, rather firm in texture, with greenish brown juicy flesh resembling the Bigarreau cherry in flavor. By means of grafting or budding, this excellent variety may be propagated for dissemination throughout many parts of the world. (Fig. 4.)

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as in many parts of Ecuador. It may be said, in fact, that of all the countries where this tree is grown Ecuador is the one where it attains its greatest economic importance, and where the finest varieties are found. Theodor Wolf, the classic writer on Ecuador, says:

"The capulí is as distinguishing a characteristic of the Sierra as is the coconut palm of the coast. I do not doubt that it is indigenous, but commonly it is found in cultivation about the huts of the Indians, and in their fields and orchards."

Beginning in the northern part of the country, the tree is common in the province of Carchi, but not really abundant. The same is true of the vicinity of Ibarra, in Imbabura province. Toward Otavalo it occurs in greater numbers and along the shores of Lake San Pablo it is very abundant in the gardens and dooryards of the Indians. In Pichincha province, again, it is less conspicuous, though not by any means wanting. From Latacunga to Riobamba it is one of the few trees which grow upon the sandy plains, and it here attains greater economic importance than in any other part of the country. In the province of Azuay, however, it is nearly as abundant and important; and in certain sections of this province, together with the neighboring one of Cañar, it assumes the appearance of an indigenous species. In Loja it is not rare, but not sufficiently common to take a very important place in the list of economic plants. Its zone, throughout Ecuador, lies between 6,000 and 11,000 feet.

In Peru we have not studied in detail the distribution of the species, but it grows in several parts of the Andean region. It is particularly abundant in the valley of the Urubamba river, near Cuzco, at elevations between 8,000 and 10,000 feet, and it is cultivated in the city of Cuzco, at an altitude of about 11,500 feet. It is significant that the Indians of Peru and Ecuador, who speak the Quíchua language, should know this plant under a name taken from the Nahuatl tongue of Mexico. The numerous inquiries which we have made of Indians in Ecuador and Peru have failed to elicit any other name than capulí. This latter has, in Ecuador, been combined with Quíchua words to form compound terms, such as *sacha-capulí* (wild capulí), the name given to an Ecuadorean tree thought to resemble the capulí in appearance; and *Capulí-urcu* (capulí mountain), the name of a small peak.

South of Peru the capulín is not well known. There are a few trees in central Chile, chiefly in gardens and parks of the region about Santiago.

If by the name capulín we designate the cultivated forms of *Prunus serotina*, and not the species as a whole (a limitation which seems altogether appropriate), then we may say that this fruit has never been extensively planted in the United States; indeed, the only recorded instances of its having been grown in our country are a few from California. Strangely enough this fruit,—which was, after the Old World species brought by the Spanish monks, one of the very first exotics to be planted in that state,—has never become widely known there, although it succeeds remarkably at Santa Barbara. F. Franceschi, in his "Santa Barbara Exotic Flora" (1895), gives a somewhat detailed account of its behavior, which we transcribe below; it may be mentioned in passing that the *zapote* of which he speaks is *Casimiroa edulis* La Llave, and the famous old tree at Santa Barbara is believed to have been planted about 1810:

"In a lot adjoining that where the old zapote grows, and very likely planted at the same time, but in rather worse condition, is a tree of the Capullin (*Prunus capuli*), a kind of cherry, native not only of Mexico but extending in the temperate regions of South America down to Ecuador and Peru, but only west of the Andes. . . . Horticulturally speaking, this tree has a special importance for us, as well as for other warm countries, being the only cherry which will thrive in this

climate, growing to very large size, and bearing a profusion of fruits which are produced in bunches, possess a pleasant bitterish taste, and are very good, also, when dried. The chief importance of this tree will be, however, in the possibility of crossing it with some of the best cultivated cherries, if artificially they may be brought to flower at the same time. *Prunus capuli* blooms as early as January, and does not ripen its fruits till July. Two splendid specimens of this tree are to be seen on Mr. Lewis' farm near Carpinteria. They are some twenty years old, and seedlings of an older tree, now disappeared, which is said to have been introduced from Ecuador."

DESCRIPTION

In Mexico and Central America the capulín rarely exceeds 35 feet in height; in Ecuador it sometimes reaches 50 feet. Professor Sargent, in his "Manual of the Trees of North America," gives the maximum height of the species as 100 feet, but adds that it is "usually much smaller, and occasionally, toward the northern limits of its range, shrub-like in habit." During the first years of growth it is slender and pyramidal in habit; later the crown becomes somewhat more broad, rarely broadly oval or rounded in outline, with rather slender horizontal branches and slender, stiff branchlets, "at first pale green or bronze color, soon becoming bright red or dark brown tinged with red, red-brown, or gray-brown, and marked by minute pale lenticels during their first winter, and bright red the following year." The bark, which is one-half to three-quarters of an inch thick, is dark gray or ashy-gray in color, and "broken by reticulated fissures into small irregular plates, scaly on the surface" (Sargent). The leaves, which are commonly three to five and a half inches long, are somewhat variable in form: usually oblong-lanceolate, and long-acuminate at the apex. The margins are finely serrate, and the upper surface glabrous, dark green and shining, the lower surface also glabrous, and somewhat paler. The flowers, which appear when the leaves are about half grown, are borne on slender racemes four to ten inches long; they are white, about half an inch broad, and delightfully fragrant.

The fruit of the wild *Prunus serotina* is described by Professor Sargent as "ripening from June to October, in drooping racemes, depressed-globose, slightly lobed, ⅓ to ½ inch in diameter, dark red when fully grown, almost black when ripe, with a thin skin, dark purple juicy flesh of a pleasant vinous flavor, and an oblong-obovate thin-walled stone, about ⅓ inch long." This description must be altered somewhat if it is to cover the cultivated forms of the species; the best capulíns of Ecuador are depressed-globose in form, sometimes as much as one inch in diameter, and may vary from light maroon to deep purplish in color. The skin is thin, but not delicate in texture. The flesh is pale brownish green, melting and very juicy, with a sweet, vinous flavor strongly resembling that of the Bigarreau type of cherry, plus a trace of bitterness which is derived from the skin. The stone is proportionately no larger than in the best horticultural varieties of the Bigarreau type.

It must not be inferred from these remarks that all capulíns, either in Ecuador or any of the other countries of tropical America where the fruit is cultivated, are of this character. The vast majority of them are not over half an inch in diameter and are large-seeded, with scanty flesh of distinctly bitter taste. So far as we have observed, Mexico possesses no forms of such excellent horticultural character as those of Ecuador, nor does Guatemala. In fact, the majority of capulíns in all these countries amply justify Theodor Wolf in remarking that the fruit "is quite acrid, and can be eaten only in a country where there is a scarcity of better fruits." No one recognizes the truth of this better than ourselves; and it is precisely because of this condition that we have undertaken

to point out, in the present paper, the distinctly superior character of the horticultural forms which have been developed in Ecuador and to urge their propagation and dissemination.

We append a note[4] on the botany of the capulín, prepared by Dr. S. F. Blake, of the Bureau of Plant Industry, U. S. Department of Agriculture, which should serve to clear up the confusion in which the subject has long been involved.

USES

The capulín is used in the same manner as the northern cherry,—for eating out of hand, for preserving, for the preparation of jams, jellies, and so forth. In those countries where good varieties occur, it is popular among all classes of people; in other regions, such as the highlands of Guatemala, for example, it is esteemed principally by the poorer classes, since there are no varieties of sufficiently good quality to attract people who can afford to purchase better fruits.

In Ecuador, the fruit plays an important rôle in the economic life of the Indians, who have come to depend upon it as an important article of diet. It ripens during the first months of the year, "precisely when the peasants, and especially the Indians, have consumed the corn of the previous season's harvest, and cannot secure sufficient food for their needy families."[5] In point of quantity consumed, the capulín is doubtless the most important fruit of the Ecuadorean highlands.

The Indians, besides eating the fruit out of hand, use it to prepare a species of *cocido* or stew. It is said that a distilled liquor, resembling *kirsch* or *maraschino*, has been obtained from this fruit in Ecuador; but this has not been verified by us personally.

The medicinal uses of the capulín are not of great practical importance, though rather numerous and often mentioned in the literature of this tree. The account we have translated above from Ximenez gives a rather complete idea of its uses in Mexico during the early days of Spanish colonization. More recent works consider an infusion of the leaves to be valuable in combatting malarial fevers, and "the bark, especially that of the branches and roots, yields hydrocyanic acid used in medicine as a tonic and sedative."

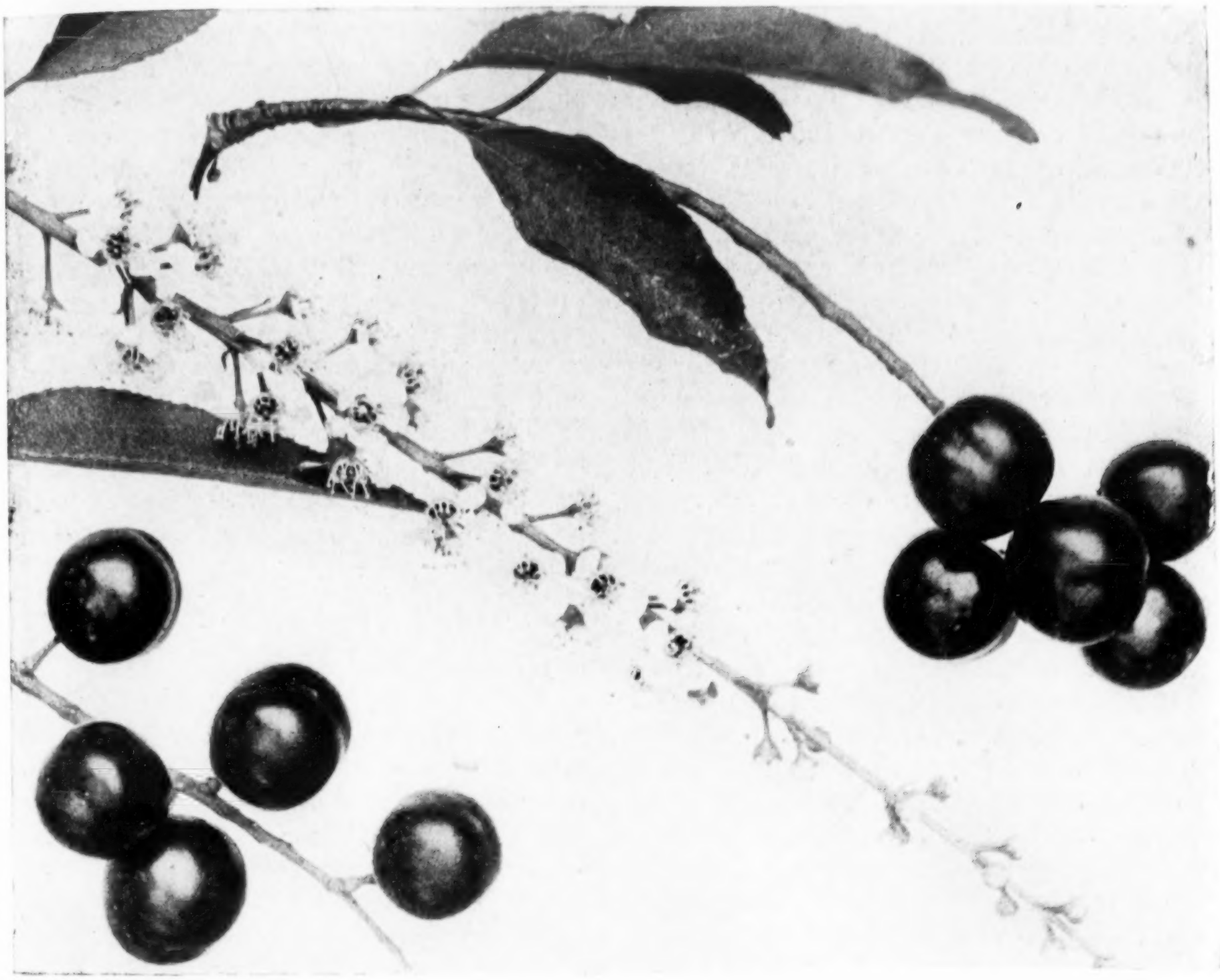
Professor Sargent, from whom we take the last observation, remarks concerning the wood of *Prunus serotina*

[4] Botanical note: the capulín or ceraso, ranging from Mexico to Peru, has received several names at different times. *Prunus capuli* Cav. Anal. Hist. Nat. Madrid 2: 110. 1800; types from Ecuador and Peru. *Prunus salicifolia* H. B. K. Nov. Gen. & Sp. 6: 241. *pl. 563.* 1824; type from Colombia. *Cerasus capollin* DC.; Ser. in DC. Prodr. 2: 539. 1825; based on drawings of Mexican plants. *Cerasus capuli* (Cav.) Ser. in DC. Prodr. 2: 541. 1825. *Prunus capollin* (DC.) Zucc. Abh. Akad. Muench. 2: 345. *pl. 8.* 1837. *Prunus serotina salicifolia* (H. B. K.) Koehne, Deutsch. Dendr. 305. 1893. It has usually been distinguished from *Prunus serotina* Ehrh. by its supposedly narrower leaves, but examination of a large amount of material shows that this character is by no means constant, since broad-leaved forms occur in Mexico and narrow-leaved forms at various places in the United States. The only distinction which appears to be at all constant is furnished by the larger fruit and stones of the capulín, but this difference is precisely the one which would come from cultivation. In his treatment of the genus in the Standard Cyclopedia of Horticulture (5: 2842. 1916), Bailey retains *P. capollin* and *P. salicifolia* as distinct from *P. serotina*, but gives no satisfactory characters for separation. Koehne, in his latest treatment of the genus (Bot. Jahrb. Engler 52: 285-9. 1915), retains *P. capuli* as distinct, but brings forward no definite characters beyond its larger stone.

A study of Mr. Popenoe's specimens and of the extensive series in the National Herbarium has convinced me that the supposed species are botanically inseparable, as was long ago recognized by Sargent (Silva North Amer. 4: 46, footnote. 1892), and that the capulín is merely a cultivated form of *P. serotina*, which is presumably native southward into Mexico and introduced in early times into South America.

The following collections by Mr. Popenoe have been examined: Guatemala: Tecpan, 1916, Nos. 752a, 752b. Colombia: Nemocón, 1920, No. 1077; Bogotá, 1920, No. 1122. Ecuador: Ambato, 1921, No. 1232; Loja, 1921, No. 1319; Cuenca, 1921, No. 1332. Peru: Urubamba, 1921, No. 1358; Cuzco, 1921, No. 1362.—S. F. Blake.

[5] "Enumeración Botanica," by Luis Cordero, published at Cuenca, Ecuador, in 1911.



THE CAPULÍN, AS USUALLY SEEN IN MEXICO AND GUATEMALA

Large fruited forms of the capulín are rare in Mexico and Guatemala. The fruits shown above, natural size, are typical of the species as grown in those countries; while larger and better than fruits of the wild *Prunus serotina*, or choke cherry of the United States, they are greatly inferior to some of the best South American varieties. The flowers of the capulín are white, and deliciously fragrant: those shown above, together with fruits from the same tree, were photographed at Antigua, Guatemala. (Fig. 5.)

that it is "light, strong, rather hard, close, straight-grained, with a satiny surface, light brown or red, with thin yellow sapwood of 10 to 12 layers of annual growth; largely used in cabinet-making and the interior finish of houses." In Ecuador and other parts of tropical America, it is much used for making furniture. It has been extensively employed, also, for railway ties, but in recent years has been largely replaced by eucalyptus for this purpose.

CLIMATE AND SOIL

While we know that *Prunus serotina*, as a wild plant, extends as far northward as Nova Scotia, we have, as yet, no proof that the cultivated form of this species, which we term capulín, will prove to be sufficiently hardy for cultivation even in the central United States. It is a fruit which has been developed on the cool plateaus of tropical America, where temperatures lower than 15 or 20 degrees above zero Fahrenheit are never experienced. A careful trial will be required to demonstrate just how much cold the choice horticultural forms of this species can withstand without injury. At present, we would not feel safe in recommending them for any sections of the United States except the Pacific

Coast, the Southwest in general, and the Gulf States. Throughout this area the tree ought to succeed, so far as resistance to cold is concerned; whether or not good fruit will be produced is another question. In tropical America the capulín seems to be at its best in a relatively dry climate. The highlands of Ecuador and the plateaus of Mexico, for example, resemble southern Calfornia much more closely, in respect to climatic conditions, than they do the Gulf States or the Pacific Northwest. True, there are many capulíns in the vicinity of Bogotá, Colombia, where rainfall is much more abundant and is distributed throughout a large part of the year. We can only suggest, therefore, that the tree is likely to find conditions the most congenial in the semiarid Southwest, but that it may succeed, also, in the Gulf States generally, and perhaps even farther north.

As to soil, the capulín does not seem at all exacting, though it grows best, so far as we have observed, on sandy alluvial loam. We have seen it on heavy clay soils, and also on dry, rocky hillsides, as well as on the loose, volcanic sands which abound in the Ecuadorean highlands. It is safe to infer, therefore, that it can be grown successfully on any reasonably good soil. We have had no means of ascertaining whether or not it is alkali-resistant to a high degree.

Very little can be said concerning the cultural requirements of the tree, since it has not been subjected to systematic cultivation in Latin America. Data are, therefore, altogether lacking. If the trees are to be planted in orchard form, we would not recommend that they be set closer than 25 feet apart. Thirty-five feet would be better, particularly if the soil is of good quality so that large trees will result. If grown in a region of little rainfall, the capulín should be watered frequently,—at least every fortnight during the first few years after planting, and later about once a month.

Little pruning will be required, aside from that necessary to form a shapely crown and to eliminate dead or unhealthy wood. Since the fruit racemes develop from the leaf axils of the young branchlets, pruning which removes many of these latter should be avoided as much as possible. The capulín, which belongs to the group of cherries that bears its fruits in racemes, is much more productive than the cultivated cherries of northern countries, all of which belong to the group in which the fruits are produced in small clusters or cymes. A single raceme of the capulín often carries from six to ten fruits, and these racemes are produced in the utmost abundance from the leaf axils of the young branchlets.

PROPAGATION AND VARIETIES

As has already been mentioned, the capulín has been propagated in Latin America almost exclusively by means of seed. In recent years, one of the present writers has shown that grafting and budding can be employed successfully—as would be expected, *a priori*, since the genus Prunus lends itself to these methods of propagation throughout the world, in many distinct species.

We are in possession, therefore, of exceedingly simple and practical means of reproducing any chance seedling which produces fruit of superior quality and is otherwise desirable. The next thing to be done is to search out these choice seedlings, secure them for propagation, and then disseminate them as horticultural varieties throughout those regions of the world in which they will succeed. We can see no logical reason why the capulín, in its finer horticultural varieties, should not become an important and popular fruit in many parts of Latin America where it is now grown solely in its inferior seedling forms; also in certain portions of the United States, in southern Europe, and generally along the shores of the Mediterranean, in many parts of Asia Minor, perhaps in South Africa and Australia, and very likely in northern India and the surrounding regions.

A GRAFTED CAPULÍN TREE, TWO YEARS OLD

Until very recent years, the capulín has been propagated solely by means of seed. Experiments at Ambato, Ecuador, have shown that it lends itself to budding and grafting. It will not be difficult, therefore, to establish as horticultural varieties the choice forms which have originated in the Ecuadorean highlands. They cannot be reproduced from seed, for the capulín, like nearly all other tree fruits, usually reverts to the wild state when propagated by this means. The tree here shown is in the Quinta Normal de Agricultura at Ambato. Dr. Augusto Martinez, director of the Quinta, stands beside it. (Fig. 6.)

The numerous attempts which we have made to send seeds from Ecuador and Guatemala to the United States have shown that they are not easy to transport. Though packed carefully and in material calculated to keep them in good condition for at least one month, they have failed to reach the United States alive. We probably have not hit upon the right method of handling them, though we believe it will yet be possible to do this, for seeds of many other species of Prunus can be shipped without difficulty.

In the United States there should be no need of bothering with seeds of the capulín, since we can doubtless utilize those of our native form of *Prunus serotina* to produce stock-plants on which to bud or graft the finest capulíns from the Andean region.

When grown from seed the capulín, like nearly all other tree fruits, tends to degenerate; and among a hundred seedlings of a choice horticultural variety, probably not more than one or two will be equal to the parent in size and quality of fruit. Vegetative propagation must, therefore, be depended upon if the occasional superior varieties which originate as chance seedlings are to be reproduced on an extensive scale.

Experiments at Ambato, Ecuador, have shown that budding and grafting are both highly successful when properly performed. Grafting is practiced between the middle of July and the first of September, at which time the trees are semi-dormant; budding, on the other hand, is most successful if performed later than this, i. e., in that season which corresponds to the northern spring if the bud is of the type known in Spanish as *ojo despierto* (pushing bud) and earlier than grafting, if of the type known as *ojo dormido* (dormant bud). The common shield bud is used, or, in the case of grafting, a cleft or crown graft.

The grafts "take" (unite with the stock) within a few weeks' time, and it is common for them to flower by the end of the first year and to bear fruit the second. The only stock-plant so far employed is the seedling capulín, but it would be worth while to test several others, such as the sour cherry.

In such a region as that of Ambato, Ecuador, where climate and soil are both favorable and where the capulín has received a certain measure of cultural attention, no two seedling trees produce fruits exactly alike. There are, in short, almost as many varieties as there are trees. Only a few are worthy of propagation, and there are usually one or two trees which acquire a local reputation for superiority—such as that held at the present day by the famous old Gonzales tree at Catiglata in the suburbs of Ambato.

Early writers frequently refer to the varieties of the capulín, but usually do not go further than to say that they are two in number, the red and the white, or the red and the yellow; this is an allusion to the variation in color which exists, the fruit of certain trees being lighter colored than the normal form, which bears cherries of a deep purplish maroon.

It is not true that there are well-defined white or straw-colored varieties; there are all gradations in color between dark maroon-purple and light yellowish red, but the great majority of trees produce fruits of the normal purple-maroon, and it is indeed rare to find one of any other shade.

Much more important, from the horticultural viewpoint, are the differences in flavor which can be noted among the fruits from different trees in any region such as that of Ambato. Those of many trees are so bitter as to be disagreeable, while an occasional variety will be found to be sweet, pleasant, and altogether delicious. It is these latter which must be sought out and propagated if the possibilities of the capulín are to be fully realized, and if it is to become eventually, as we confidently believe it will, a popular fruit throughout the subtropical regions of the entire world.

MENDELISM IN FUR SHEEP CROSSES—II

THE ZYGOTIC CAUSE OF RED LAMBS, WHEN FUR SHEEP ARE CROSSED ON LONGWOOLS OR THEIR GRADE OFFSPRING

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IN A PREVIOUS article, published in the JOURNAL, it was shown from results obtained, that homozygous Karakul sires crossed on Longwool ewes gave complete dominance of black fur. However, a red lamb appeared occasionally. This red individual was of a different color from either of the original parent phenotypes.

In the JOURNAL OF HEREDITY, Vol. V, No. 4, April 1914, Dr. C. C. Young frequently mentions the lack of any systematic breeding methods among the breeders of fur sheep in their native home. He states that in May 1913 he imported a herd consisting of seventeen Karakuls, one four-horned, fur-bearing Karachiev ram, and one enormous *red* Kalmik, fat-rumped ram. He further states as follows, "The furriers who in their ignorance call Karakul skins, either full bloods or grades, 'Persian,' 'Persian Baby Lamb,' 'Persian Broad-tail,' or 'Astrakan' furnish the opportunity for certain breeders of *red* Persian, fat-rumped sheep, to dispose of their stock as 'Persian Broad-tails.'"

In view of these statements it is apparent that some so-called full blood Karakuls may carry the red factor recessively, due to crossing on these red strains in their native country. Unfortunately, from a scientific standpoint, the red lambs produced at the Dawley Farm were eliminated from the flock. Their skins, in every instance, were undesirable commercially, due to the fact that apparently the red color factor was correlated with loose, dull fleece. The exact behavior with respect to white and black fleece was, therefore, not established by direct crossing. However, it is unquestionably dominant to white (longwool) and recessive to black (Karaku!). Pure-bred Longwools bred pure do not produce red lambs. In correspondence with Longwool associations and breeders no record could be found of a red lamb produced by registered Longwools, thus showing their freedom from the red color factor. On the other hand, Professor R. Owen Wahl, chief in charge of fur-sheep breeding work for Grootfontein School of Agriculture, Middleburg (Cape), South Africa, recently stated they had a full-blood Karakul ram in their stud that produced red lambs when crossed on full-blood Karakul ewes.

In 1912 Mr. F. E. Dawley, Fayetteville, N. Y., crossed full-blood Karakul sires on registered Lincoln, Leicester, Cheviot, Black Faced Highland and Cotswold ewes; this cross produced 106 black lambs and one red. In 1913 using the same cross, 111 were black and one was red. Both reds were by the same sire, but, the 1912 red was out of a Leicester ewe while the 1913 red was out of a Lincoln. The behavior of red with respect to white, in this case, can be explained when it is known that the reds in question were really not true red but more of a chocolate color. True reds were later produced in the F_2 generation by another sire.

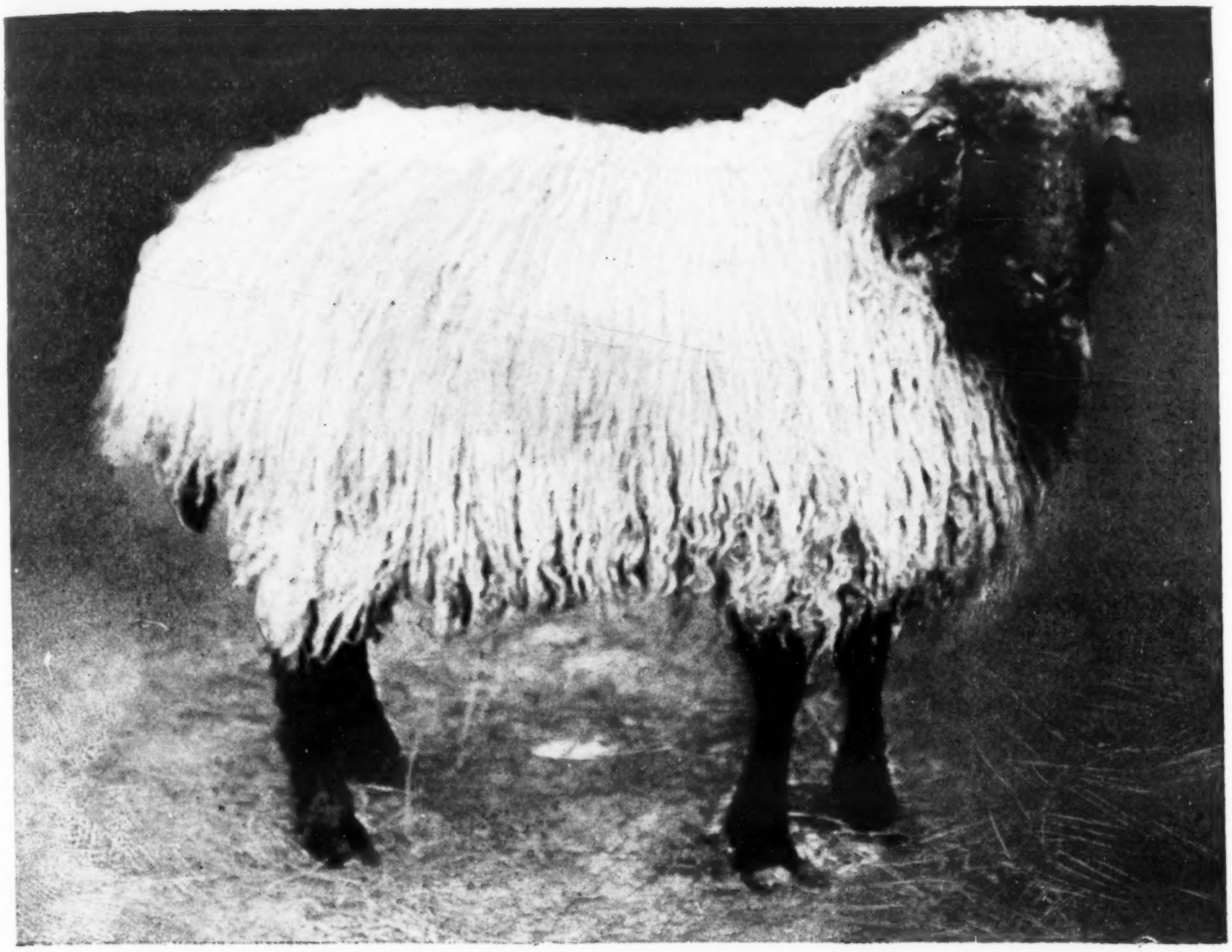
Let (B) represent the black factor and (R) the red factor, then (b) and (r) show their respective absence. The Karakul sire, which produced the chocolate colored lambs, is homozygous for black color, but heterozygous for red color. He then has the zygotic constitution, with respect to color, of (BBRr), while the ewes are (bbrr). The sire forms gametes (BR) and (Br) in equal ratio, the ewes form gametes (br) only.

WHITE LONGWOOL EWES AND THEIR BLACK LAMBS

When longwool ewes are bred to full-blooded Karakul rams, the lambs are always black, and have wool of the popular "Persian lamb" type. The geneticist accounts for this fact by saying that black wool, with its correlated desirable factors of tight curl, density, and lustre is dominant over white, slightly curled wool. Black hybrid ewes of this type are in some cases worth as much as $250 each. (Fig. 7.)

On crossing, union occurs between gametes (BR), (Br), and (br) forming a heterozygote of the combination (BbRr) or (Bbrr). Both these zygote forms should be phenotypically black in color. In the case of the two chocolate colored lambs produced in 1912 and 1913 they could just as logically, from a genetic standpoint, have been called light colored blacks, in fact they were more black than red. As to why these particular two individuals should be light colored and not all others with the same zygotic combinations, can only be explained by assuming that the particular black factor in the form (BbRr) in their case failed to give complete dominance. The results obtained later when the black F_1 ewes were crossed further strengthen the above assumption.

In 1914 the F_1 ewes were bred to an imported full-blood Karakul ram named Pultava. This ram, it was naturally supposed, would give complete dominance of black fleece, together with its correlated desirable factors of tight curl, density and bright luster. Fifty-six F_1 black ewes bred to Pultava in 1914 produced 41 blacks, 11 red or spotted, and 11 whites. In 1915 he was bred to 100 black F_1 ewes, as the 1913 ewe lambs were now ready to breed, and produced 80 blacks, 17 red or spotted, and 14 whites. The two years then give the produce of 156 F_1 ewes, with a combined total of 174 lambs of which 121 were blacks, 28 red



PULTAVA, AN IMPORTED KARAKUL RAM

He was supposed to be a pure blooded Karakul, but proved not to be as he sired many red, white, and spotted lambs. About one-third of his offspring were off color, showing that he was heterozygous for these desirable factors, and of little value for breeding purposes. Karakul sheep are black but as they grow older their fleece turns gray, or nearly white, only the short hair on legs and face retaining its original color. (Fig. 8.)

or spotted, and 25 whites. The question now arises, was this appearance of such a large number of white, red, and spotted lambs due to the known heterozygous condition of the F_1 ewes, or was it the fault of the full-blooded, imported sire, Pultava? Apparently Pultava was the cause. On the basis assumed in the original hypothesis one of the 1912 and 1913 sires was heterozygous for red (R), giving him the form (BBRr). The Longwools (bbrr) producing heterozygotes (BbRr) and (Bbrr) in equal ratio. However, the second sire produced no light colored blacks out of over 100 lambs; it is therefore safe to assume he was free from the red color factor (R), making his zygotic form (BBrr), with possible gametes of (Br) only. The resulting zygote from a cross on the Longwools would contain only a single dose of the black factor (B), although, of course, it is possible for a zygote, if properly made, to have a double dose of any factor. The only possible zygotic form for the F_1 ewes with respect to color then is (Bbrr) and (BbRr), with a mathematical ratio of three (Bbrr) forms to one (BbRr) form, because one sire produced only (Br) gametes, while half of the other sires' gametes were (Br) also.

When the F_1 ewes form gametes a separation takes place between the part of the zygotic cell containing (B) and the part which does not contain it (b). Half of the F_1 gametes, therefore, will be carriers of the black factor (B), which is apparently correlated with the

ONE OF THE RED LAMBS SIRED BY PULTAVA

His dam was a black first generation hybrid ewe, like the lambs shown in fig. 8. Had his sire been a pure Karakul he would have been black, and a valuable animal from the breeder's point of view. The relationship of these color factors is of great practical importance in producing high grade fur sheep. (Fig. 9.)

desired density, luster and curl, and half of the gametes will be totally lacking in this factor (b).

It is evident Pultava could not have been homozygous for the black factor (B), because he produced many red, spotted, and white lambs. Assuming then that Pultava had to be heterozygous for the black color factor (B) he could have had any one of the following heterozygotic forms with respect to color factor red (R): 1. (BbRR) 2. (Bbrr) 3. (BbRr). Running through the series of possible heterozygotic forms for the F_1 ewes, mating from this assumption would have resulted as shown in Table I.

Of the three possible forms listed in Table I it is apparent Pultava could only have been of the form (BbRr). The theoretical possibilities are very close to the actual obtained results; as is shown in Table II.

It must be remembered, however, that twenty-five percent of the F_1 black ewes have a possible heterozygous constitution of (BbRr); crossing these gametes gives results as shown in Table III.

Again the theoretical possibilities check close enough with the obtained results to make the (BbRr) assumption entirely probable; as is shown in Table IV; the apparent difference of 33 to 28 and 11 to 25 is not significant when it is remembered that the average ratio of

A SIX HORNED KARACHIEV RAM

The rams of this strain normally have four horns, the ewes two. His parents were normal Karachiev sheep, and all his offspring by ewes of this breed have had the usual complement of horns. When bred to Lincoln ewes all of his lambs were without horns, so that the genetic factor producing extra horns seems to be entirely lacking in dominance. (Fig. 10.)

3 to 1 of Table II and Table IV must be considered in the final analysis.

The average ratio of Tables IV and VI must be considered when figuring the average total theoretical possibilities, and checking same with obtained results. The average of these two tables based on their 3 to 1 ratio gives results as shown in Table V.

The average brings the theoretical possibilities still closer to the obtained results and further strengthens the assumption that the heterozygotic form of Pultava, with respect to color factors was (BbRr). It is assumed that reds and spotted had the same heterozygotic form in their germ cells, with respect to color factors. With the exception of two lambs which were of black mosaic pattern the spotted lambs showed a predominance of red pattern. The black mosaics must have been of the form (Bbrr), although the forming of a mixed phenotype of this combination is apparently of infrequent occurrence.

The zygotic relationship of these color factors and their respective absence is very significant from a practical standpoint, due to the character of the various skins produced. Even though

the fur is black in color there is a vast difference in shade, density, pattern arrangement, and luster. In the F_1 generation no extremely high class skins were obtained, although some of the skins from this first cross sold as high as $18.00 to $25.00. Due to the heterozygous condition of Pultava there were only a few high class skins produced in the second cross; however, had Pultava been homozygous for black and free from red, high class skins would have been much more frequent, due to the fact that the desirable qualities previously mentioned are unquestionably closely correlated with black color. The lambs having high class skins should be of the zygotic form (BBrr) with respect to color factors. The zygotic constitution of the grade ewes is, therefore, very significant also.

Professor R. Owen Wahl, of South Africa, who has bred fur sheep for years, reports similar results from using one particular ram of supposed full-blood origin. His results check with the data presented. They obtained all forms of blacks, spotted, reds and whites.

The Karachiev is a strain of fur-bearing sheep in which the rams normally have four horns, while the ewes have only two. A six-horned ram was dropped by a normal two-horned Karachiev ewe, at the Dawley Farm, Fayetteville, N. Y. The sire of this six-horned individual was a normal four-horned Karachiev ram. In all cases where this six-horned ram has been bred to Karachiev ewes the ram lambs have had the normal four horns and the ewe lambs two horns. He has been bred to a few Lincoln ewes and none of the lambs have had horns, although lambs of both sexes have been produced.

TABLE I

Zygotes

Pultava. $\times$ *75% F_1 Ewes.* = *Black. Black. Black. Red.*

1. (BbRR $\times$ (Bbrr) = (BBRr) (BbRr) (BbRr) (bbRr)

Black. Black. Black. White.

2. (Bbrr) $\times$ (Bbrr) = (BBrr) (Bbrr) (Bbrr) (bbrr)

Black. Black. Black. Black. Black. Black. Red or spotted White.

3. (BbRr) $\times$ (Bbrr) = (BBRr) (BBrr) (BbRr) (Bbrr) (BbRr) (Bbrr) (bbRr) (bbrr)

TABLE II

		Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:		8	6	1	1
" "	$\times$21.75	174	130.5	21.75	21.75
Obtained Results:		174	121	28	25

TABLE III

Pultava $\times$ *25% F_1 Ewes.*

(BbRr) $\times$ (BbRr) =

Blk. (BBRr) *Blk.* (BBRr) *Blk.* (BbRR) *Blk.* (BbRr) *Blk.* (BBRr) *Blk.* (BBrr) *Blk.* (BbRr) *Blk.* (Bbrr)

Spotted

Blk. (BbRR) *Blk.* (BbRr) *Red.* (bbRR) *or Red.* (bbRr) *Blk.* (BbRr) *Blk.* (Bbrr) *or Red.* (bbRr) *White.* (bbrr)

TABLE IV

		Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:		16	12	3	1
" "	$\times$10.9	174	130.5	32.6	10.9
Obtained Results:		174	121	28	25

TABLE V

	Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:	174	130.5	24.5	19.0
Obtained Results:	174	121	28	25

"THE CATLIN MARK"

The Inheritance of an Unusual Opening in the Parietal Bones

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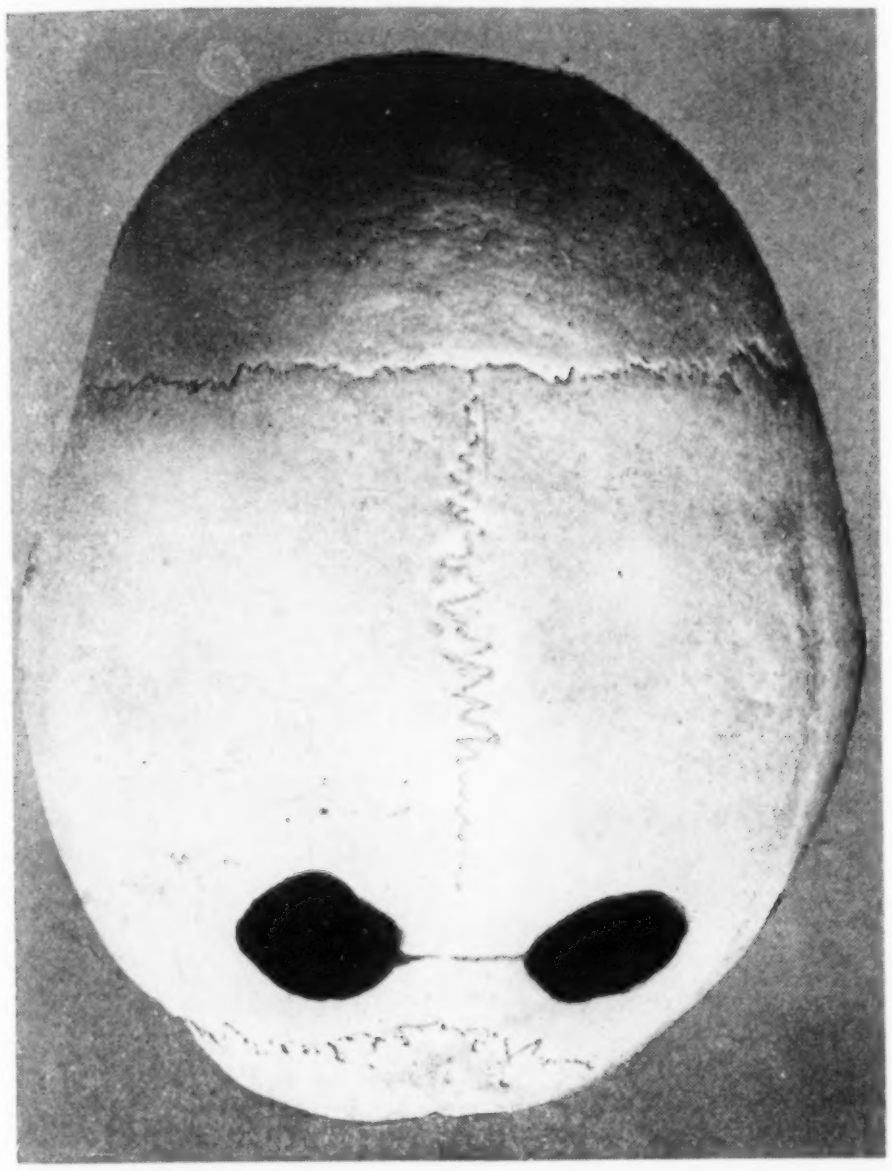
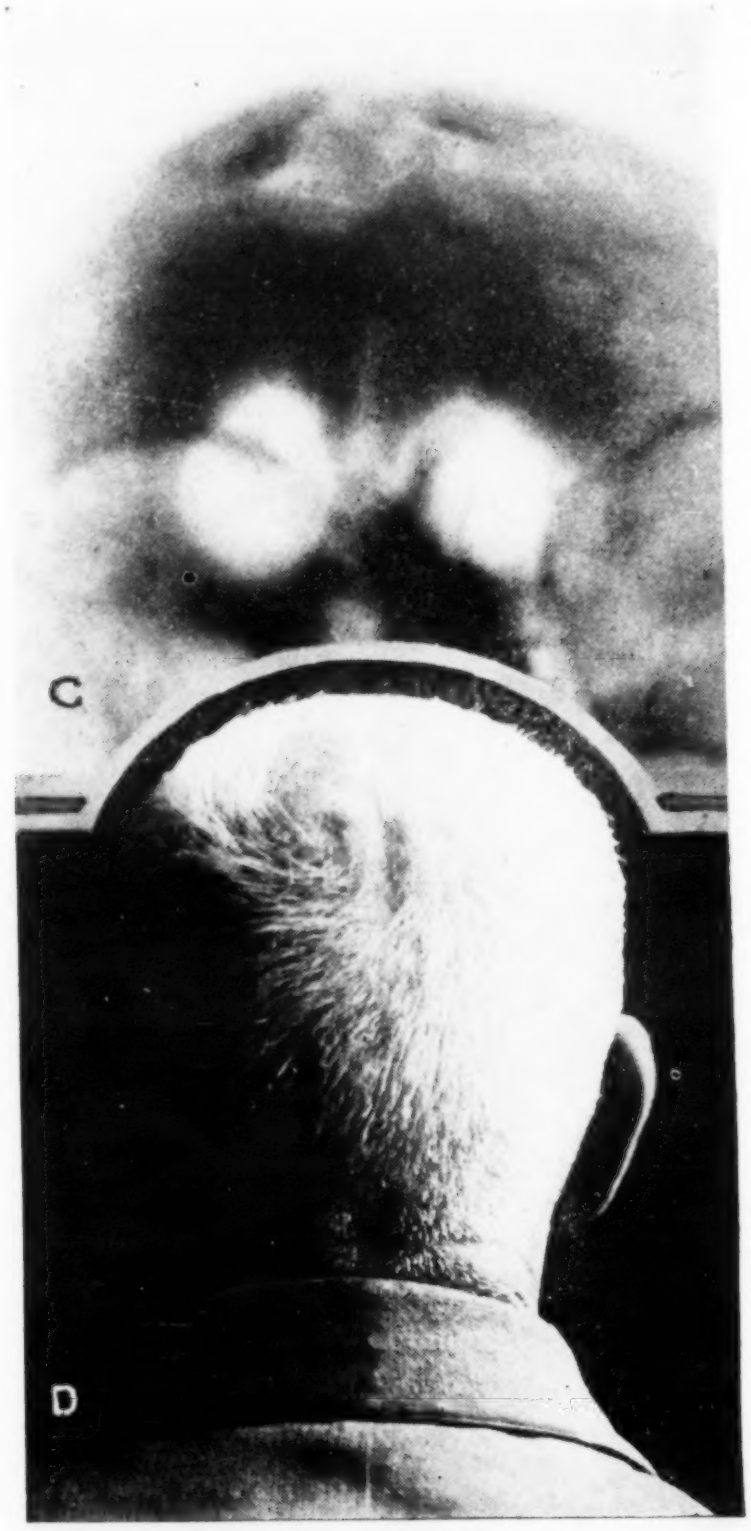


"EYES" IN THE BACK OF HIS HEAD

This is not, as it appears, an attempt on the part of nature to meet the proverbial small boy's demand for "eyes in the back of his head." The holes serve no such useful purpose, but show the inheritance of an entirely useless or even injurious character. (Fig. 11.)

THE accompanying figures are intended to present certain facts regarding the inheritance of a very unusual defect, namely, an opening in the parietal bones. The radiographs show the position of the opening. The exact location is more clearly shown by the picture of the skull. (Fig. 11.)

In the particular individual, whose radiograph is shown in C, Fig. 12, the opening in the left parietal is larger and more irregular in contour than the right. It will be noted in D, that the father of C has a similar skull defect. Furthermore, as the family chart shows, Mr. Catlin, III, 6, has two brothers and one sister similarly affected. The "mark" was traced up the male line to the grandfather of the man whose photograph is shown in Fig. 12 where the history was lost. (See Fig. 13.)



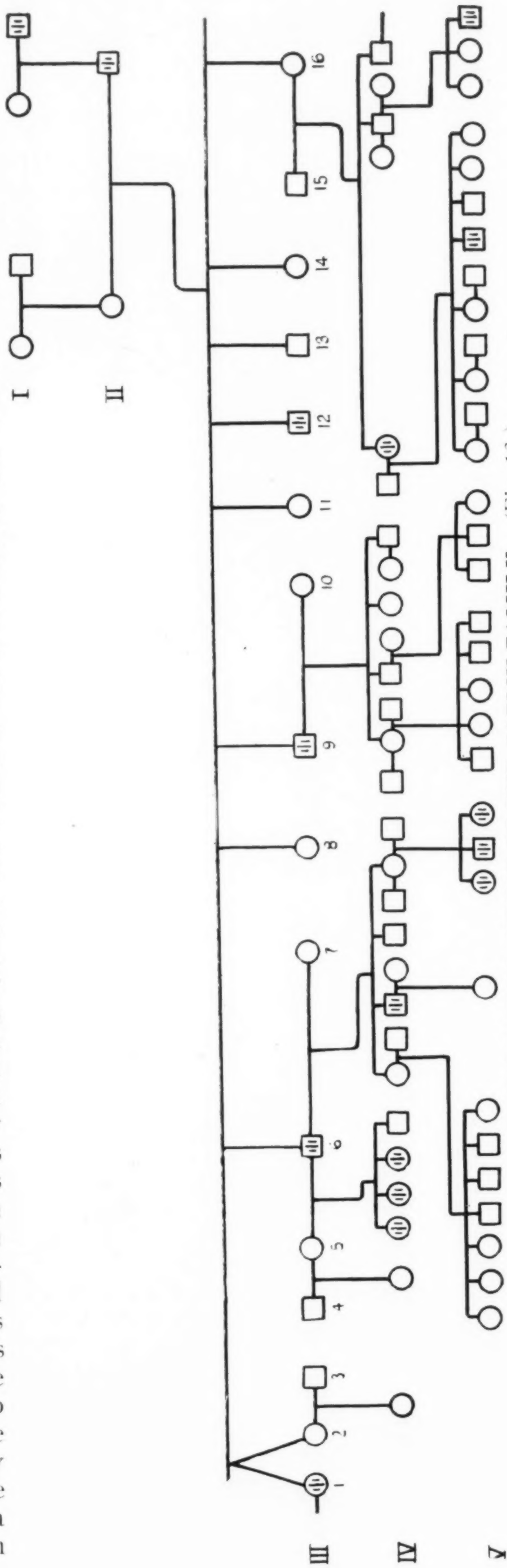
TWO VIEWS OF THE "CATLIN MARK"

Above (C), is shown an X-ray photograph of the defect in the skull of one of the daughters of the man shown below (D). The presence of this defect in the skull has no influences on mentality, and causes only slight inconvenience, although a baby with a large "Catlin Mark" is more liable to injury at birth. (Fig. 12.)

The four branches of the family which produced offspring are indicated on the family chart. The affected

members of the family are indicated. The hereditary defect did not seem to fall in line with the usual laws of inheritance; however, sufficient evidence was not available for a definite conclusion.

Aside from the transmissibility, it is interesting to note that the size of the openings varies to a certain extent with the age of the individual. Figures 14 and 15 are skiagraphs of the skulls of the younger members of the Catlin family. It will be noted that in each case the two holes are so large that they are continuous save for a median cartilaginous septum which is not clearly differentiated by the X-ray. In most cases it is claimed that the original single large elongated opening of the young is later developed into two more or less circular ones by the ossification in the median region. For example, Ruth, whose "mark" is shown in C, claims that in childhood there was only a single elongated opening in her skull, as is the case with one of her younger sisters whose "mark" is shown in Fig. 15. The suture lines between the two holes in the skull shown in C unite with the sagittal suture in such a way as to suggest that the median bridge is formed by a simultaneous upward ossification of the lower median side of the elongated opening and a downward ossification of the upper median region. This gives four centers of ossification, an upward growth from the median edge of each parietal and two similar downward ossifications. In many cases an elongated concavity remains in the median septum as shown in D, Fig. 12. Although this post natal ossification is marked in some individuals the septum between the openings does not form at any particular age. Some children were found who possessed openings in the skull as large as a twenty-five cent coin. This fact might help to explain why the transmission of the defect appears to be so haphazard. It is quite possible that the "mark" appears in many individuals not so indicated on the chart. In one particular case, a mother contended that her small son



GENEALOGICAL CHART OF THE CATLIN FAMILY. (Fig. 13.)

THE "MARK" IN CHILDHOOD

Like the normal opening that occurs in the skull in infancy, and closes by the end of the first year, this opening grows smaller, and in some cases closes entirely with age. Frequently it appears as a single large hole, or with a very slight suggestion of a median bridge, as in this case. (Fig. 14.)

was normal in this regard when an examination revealed a slight abnormal concavity in the skull where the openings were expected. In this case the X-Ray would not show the defect, but the boy was recorded as having an abnormal skull. Unquestionably many of the individuals who are shown in the chart as normal, possessed the defect in fœtal or embryonic condition.

The "Catlin Mark" does not seem to be a serious handicap to its possessor. After considering the individual cases it was readily seen that no relation existed between the defect and mentality. The family as a whole would be classed as "average." One boy who had no signs of the mark is retarded in the grades while another child who has unusually large openings in the skull is quite successful in school work. Those who have the defect claim that any stroke on that part of the head causes unusual pains and headaches. The young ladies say that in case the hair is dressed a certain way a pressure is exerted and violent headaches result. To this extent, only, is the defect an inconvenience to an otherwise normal individual. However, the family physician claims that a child with an extreme "Catlin Mark" is more liable to injury at birth than a normal child.

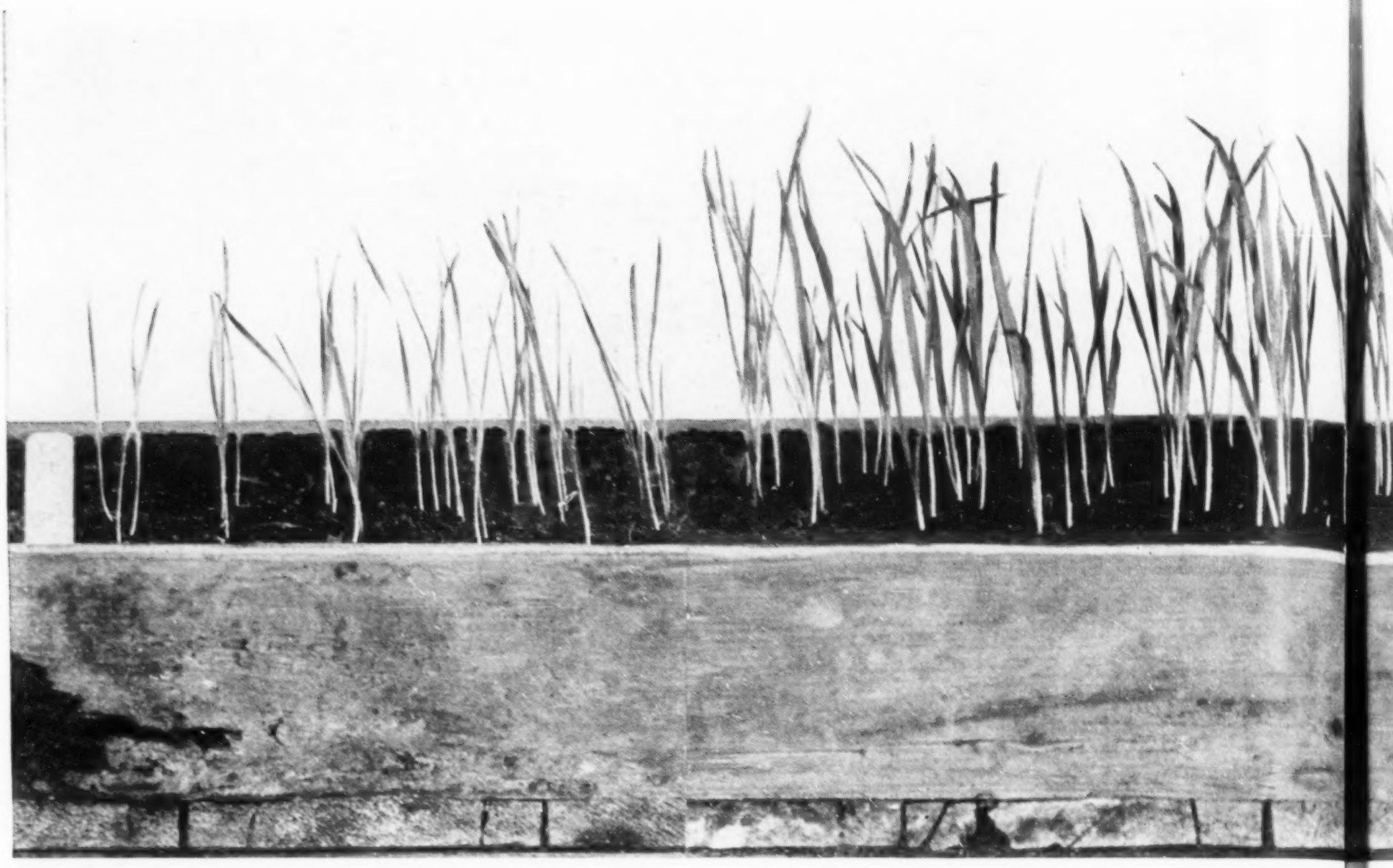
A SINGLE LARGE "MARK"

Later in life this hole will partly close, and be divided into two smaller ones by the formation of a median septum. In view of the existence of such natural defects, one is led to wonder whether some cases of trephining reported by archeologists may not be due to such a defect as this. Primitive man undoubtedly did perform operations on the skull, but in some of the examples found the holes are remarkably smooth, suggesting an origin similar to the above. (Fig. 15.)

The Undeveloped Mind

THE PSYCHOLOGY OF CHILDHOOD, by Naomi Norsworthy, Ph.D., formerly associate professor of educational psychology, Teachers' College, Columbia University, and Mary Theodora Whitley, Ph.D., assistant professor of education in the same college. Pp. 375. Brief Course series in Education, New York, The Macmillan Co., 1920.

This textbook for normal schools covers in a rather complete way the original nature of the child, with reference to methods for educating or modifying it. Particular pains are taken to attach the proper importance to heredity—in this respect the book is a model of its kind, even though the discussion of the theoretical phases of genetics is hardly up to date. In general, the volume presents the point of view associated in psychology with the name of E. L. Thorndike. While intended primarily for embryonic teachers it should be of interest and value to well-educated parents also.—P. P.



BARLEY GERMI

On the left are plants grown from seeds harvested only six days after they were pollinated; on the right are plants old weighs only 5 milligrams, instead of 35 milligrams for a normal adult grain. The small seedlings, although much

THE GERMINATION OF BARLEY SEEDS HARVESTED AT DIFFERENT STAGES OF GROWTH

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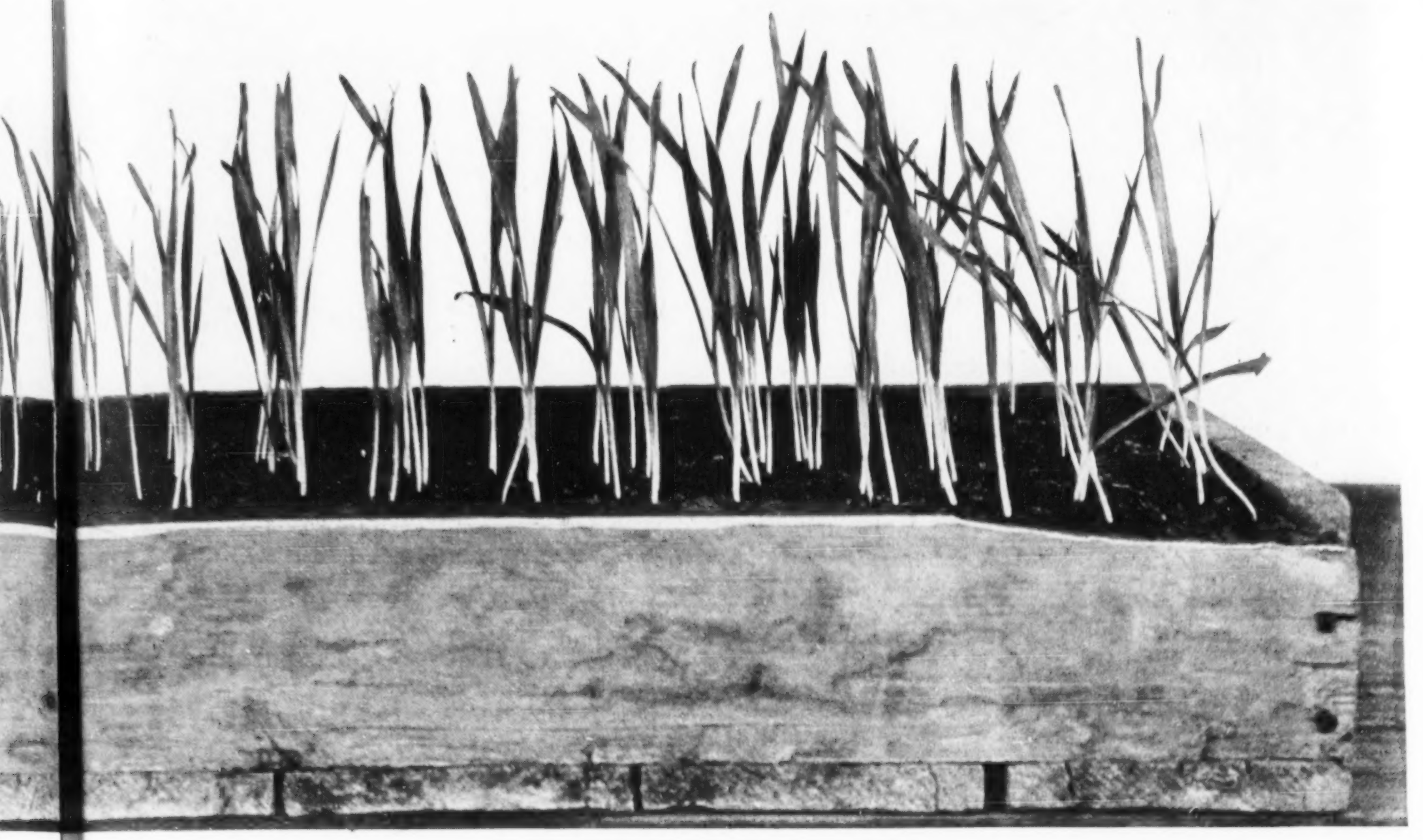
AT ABERDEEN, Idaho, where these experiments were conducted under irrigation, in cooperation with the Idaho Agricultural Experiment Station, a kernel of Hannchen barley is normally mature at 26 days after flowering. In 1920 an experiment was undertaken to determine the earliest date after pollination at which seeds were sufficiently developed to germinate. In this experiment samples from seven varieties were taken. Three of these varieties were six-rowed and four were two-rowed. Sufficient spikes of equal development were tagged in each variety. The dates of flowering of the spikes were determined by observations and later checked by measurements of the kernels. These dates are not absolutely accurate as the flowers on a spike are not all fertilized on the same day. In all varieties the tip and basal flowers are pollinated later than those on the central part of the spike.



LEY GERMINATION

ght and ants from mature seeds, with intermediate stages at intervals of one day. The dry matter in a barley seed six days though much more slender than those from mature seeds, develop normally and produce seed. (Fig. 16.)

In the six-rowed varieties the flowers of the central rows are pollinated before those of the lateral rows.

In four of the varieties the first samples were taken six days after flowering. In one variety the first sample was taken seven days, in a second, eight days, and in a third, nine days after flowering. These samples were taken by cutting the culms and placing the spikes in paper envelopes. The seeds were not taken from the spikes until the following winter when the germination was tested by sowing the seeds in flats in the greenhouse at Arlington Farm, Virginia. The seeds were placed in rows spaced at definite distances and covered lightly with soil.

When the experiment was planned in 1920 it was thought that germination would first occur in seeds which had developed for about 14 days. In mature seed the embryo is provided with an epithelial layer which secretes the diastase necessary for the digestion of the starch endosperm. The epithelial layer is not fully formed until about the 14th day after the flower is fertilized. There are several other changes that take place at this time which indicate approaching maturity. A secondary stage of starch formation commences. The peak of the water content of the kernel is reached at this time.

It is readily seen in the table that the hypothesis of time of germination was not correct. It was thought that all samples were taken sufficiently early to show the inception and gradual increase in percentage of germination. All of the varieties showed germination at six days from flowering. The Baku variety gave a perfect percentage of germination at that age. It may be possible that the Gatami shows the progress that should be expected. On the 6th day after flowering four of the seven central kernels germinated while only three of the seven lateral ones germinated. On the 7th day all of the central kernels were viable while only six of the seven lateral ones grew. It was not until the 8th day after the spikes were recorded as flowering that

all of the lateral kernels could be germinated. The flowers of the central spikelets are pollinated first. The lateral ones usually are pollinated one or two days later.

Barley kernels six days of age are very small. They have a very high water content and when dried are so small and brittle as to be difficult to handle. In the average kernel of Hannchen barley at this stage there are only 5 milligrams of dry matter, while at maturity there are 35. The plants produced from these small kernels are very slender and the first leaves are very small. They are perfectly normal, however, and develop into normal plants which produce seed. When grown under the conditions of this experiment the adult plants were not as robust as those from mature seed, but this may have been a result of their having been transplanted. The seedlings were progressively taller and had greater diameter of stem with the increase of the age and size of seed, as may be seen in Fig. 16.

In 1921 a more accurate study was made with Hannchen barley. Several hundred flowers were emasculated within a period of three or four hours. Two days later these were hand-pollinated and a record made of the exact time of pollination. As barley pollen either germinates or dies within a few minutes after the anther is ruptured, the ages of these kernels are known certainly within one hour. As will be seen in the

Results of experiments in germination of kernels of barley varieties harvested at different stages of development after flowering

	1920																1921	
	Himalaya				Gatami				Manchuria				Hann-chen		Jet		Baku		Chev-alier		Hann-chen	
Days from Flower-ing	Cen-tral Ker-nels		Later-al Ker-nels		Cen-tral Ker-nels		Later-al Ker-nels		Cen-tral Ker-nels		Later-al Ker-nels											
	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	9
6	9	8	10	8	7	4	7	3	...	...	...	...	...	...	...	...	5	5	10	4	10	6
7	10	9	10	9	7	7	7	6	10	10	9	9	...	...	...	...	3	2	10	8	10	6
8	9	9	9	6	8	8	8	8	12	12	12	10	9	8	...	...	5	4	12	11	10	8
9	10	9	10	10	7	5	7	7	11	11	9	9	12	11	6	6	5	5	11	9	10	7
10	10	10	10	10	10	10	10	9	13	13	13	12	11	11	4	4	5	5	10	10	10	2
11	10	10	10	10	8	7	8	7	8	8	8	7	13	13	6	6	7	7	12	10	...	...
12	7	7	7	7	8	8	8	7	7	7	7	6	10	10	4	4	7	7	10	8	...	...
13	8	8	8	8	9	9	7	7	11	11	9	9	12	12	6	6	4	4	...	...	...	...
14	10	10	10	10	6	6	6	6	7	7	7	7	11	11	8	8	6	6	...	...	...	...
15	9	9	9	9	7	7	7	7	10	10	9	9	13	13	7	7	7	7	...	...	...	...
16	10	10	11	11	8	8	8	8	12	12	12	12	12	12	7	7	6	6	...	...	...	...
17	9	9	9	9	7	7	7	7	12	12	12	12	10	10	8	8	8	8	...	...	...	...
18	10	10	10	10	7	7	7	7	9	9	9	9	10	10	7	7	6	6	...	...	...	...
19	9	9	8	8	8	8	8	8	13	13	11	11	10	10	8	8	8	8	...	...	...	...
20	9	9	9	8	7	7	7	6	...	...	...	...	...	...	7	7	7	7	...	...	...	...
21	...	...	...	...	7	7	6	6	...	...	...	...	...	...	9	9	8	8	...	...	...	...
22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	7	6	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	8	8	...	...	...	...
24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	6	6	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	6	...	...	...	...	...	...

table, nine out of ten kernels germinated at an age of five days from the time they were pollinated. The fact that so many kernels germinated at five days and the irregularity of the later germinations indicate that an occasional seed might be found which would germinate at less than five days.

There is some question as to the effect of the kernels being allowed to remain on the spike as was done in this experiment. The spikes dry very rapidly at Aberdeen. It is thought that no additional material enters the seed from the spike for a period longer than one hour after the culm has been severed from the plant. Further experiments are being conducted to discover more of the details of germination at early ages.

SOME POINTS ON THE RELATION OF CYTOLOGY AND GENETICS

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IT IS necessary to point out certain misstatements of fact made by Miss E. Eleanor Carothers in her review of Sharp's *Cytology* in the Journal of Heredity (Vol. 12, p. 351). This is not the place for a discussion of detailed cytological points, and reference will only be made to certain general features, particularly those having a direct bearing on genetics. Miss Carothers has rightly pointed out certain defects in the work in question which are capable of being remedied in a later edition. But she makes a serious blunder in discussing the phenomena of meiosis in plants, with which she evidently has had little experience. She refers to the statement of Sharp that in diakinesis the heterotype chromosomes contrast strikingly with the chromosomes in an ordinary somatic prophase, whether they are secondarily split or not. But she goes on to affirm that "this 'striking contrast,' however, depends wholly upon the fact that the chromosomes are secondarily split, that is that they are tetrads and not dyads." She also states that she "has had enough contact with botanical material to be confident that this statement is true for plants as well as animals."

This statement is particularly unfortunate, because the understanding of meiosis as it occurs in most plants was retarded for a decade by the search for "tetrads" where they do not exist. It is now well recognized by most plant cytologists that in the majority of plants tetrads do not occur, and that the essential feature of the heterotypic mitosis is the separation of pairs of whole chromosomes. It is easy for such pairs of chromosomes (gemini) to be mistaken for tetrads through a superficial examination, particularly if the observer has the necessity for finding "tetrads" already in mind. As regards animals, there are many instances in which clear tetrads have been observed, but that they are certainly not universal is shown, for example, by the history of the X Y chromosomes in many forms, to take a single example. Some of the more careful recent papers on animal spermatogenesis discard the conception of tetrads and speak of bivalent chromosomes in diakinesis.

The presence of tetrads merely indicates that the paired chromosomes have themselves split before the separation of parts begins. Such a split is necessarily precocious. When this split occurs in the heterotypic anaphase or telophase, as it does in Oenothera and Lactuca among forms which I have studied critically, then obviously the

chromosomes will be bivalent and not tetravalent in diakinesis or the heterotypic prophase.

From a genetic point of view also it is particularly desirable that the conception of tetrads should not be introduced where they do not exist. In such cases the essential feature of meiosis is the *separation of the chromosome pairs*, and the complications introduced by the formation of tetrads and the resulting possibilities in the distribution of the four segments in the two divisions, do not arise.

Whether the pairing of chromosomes is parasynaptic or telosynaptic is, therefore, a matter of cytological detail which need not *necessarily* affect the distribution of the chromatic material. But this is a subject into which I do not propose to enter here. One must expect to find differences in detail, and even in important points as well, between the phenomena of meiosis as observed in different organisms. The time has passed when it is reasonable to try to squeeze them all into one mould. Since considerable attention has been given recently to the cytological basis of "crossing over" it may be worth while referring to a few points in this connection, in order to show that some plants provide a cytological basis for such phenomena while others do not.

It was recently shown that in Lactuca[1] the chromosomes in early diakinesis are twisted around each other, and that this twist often persists as the chromosome pairs condense. This would lead to a breaking across the twist when the pairs separate, in other words to crossing over. Such twisted pairs of chromosomes have often been figured during diakinesis in various plants, for example in *Adoxa moschatellina*[2] and in Smilacina.[3] But I believe the later consequences of the twist have first been traced in Lactuca. In sharp contrast to the twisting and probable crossing over of chromosome segments in Lactuca is the condition in Oenothera, where such twisting has never been seen and is not to be expected on account of the short and stout shape of the chromosomes.[4] As is well known, in Oenothera the chromosomes form a chain end-to-end like a string of sausages, and when they ultimately come to be side-by-side in diakinesis they are already in the short and stout condition in which twisting about each other is impossible. This is a very disturbing fact for those who write about "crossing over" in Oenothera, and obviously if such crossing over occurs in Oenothera the phenomena will have to find some other explanation.

[1] Gates and Rees. 1921. A cytological study of pollen development in Lactuca. Annals of Botany 35: 365-398, pls 4.

[2] Lagerberg, T. 1909. Studien über die Entwicklungsgeschichte und systematische Stellung von *Adoxa moschatellina* L. Kungl. Svensk. Vet. Akad. Handlingar, Vol. 44, No. 4.

[3] Lawson, A. A. 1912. A study in chromosome reduction. Trans. Roy. Soc. Edin. 48: 601-627.

[4] See Gates, R.R. 1908. A study of reduction in *Oenothera rubrinervis*. Bot. Gazette 46: 1-35.

EUGENICS AND HUMAN MORALITY[1]

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WHENEVER people meet nowadays to discuss delinquency, there is likely to be heard a complaint that the accepted standards of conduct are coming to be more and more disregarded; that the old ideas of morality are going into the discard; that the younger generation, in particular, is less and less influenced by the customs of respectability and decency which had, it is averred, a binding power a few decades ago.

It is, therefore, desirable that the current ideas about morality be carefully examined by all thoughtful people. Such an examination involves some of the broadest and most fundamental concepts with which the human mind has dealt. Whole libraries of books have been written on or about the subject. I am sure I will be pardoned, therefore, if I attempt to do nothing more than indicate a few of the salient points in a single line of reasoning. This line of reasoning will lead to the conclusion that better and more widely observed standards of morality depend largely on an increase in the average level of intelligence of the population; which increase is in turn dependent on changes in the birth rate. This is, of course, only a single point of view of an extremely complex subject which also can be, and ought to be, viewed from other angles.

To begin, then, what is morality?

A man's conduct or behavior, as it affects others than himself, is influenced by a wide variety of factors, and to the working of certain groups of these the term "morality" is loosely and often vaguely applied. For the present purpose it will be convenient to review a few of the kinds of influence that have determined the nature of human conduct at one time or another. Without going into a critical or exhaustive analysis of the subject, one may readily recognize five categories.

THE ELEMENTS OF MORALITY

1. *Instinct.* In lower animals, conduct is directed largely, in most cases wholly, by certain innate and slightly modifiable tendencies, desires, and impulses which are often loosely grouped together under the name of instinct. No doubt man in his earliest period was so guided,—as he is still to a large extent. But as he became more of a social animal, mere instinct did not suffice. True, the instincts for action in conformity with "the herd" are just as genuine as the instincts for wholly selfish action. But some of the more powerful instincts, such as those connected with pugnacity, deceitfulness, hoarding, and sex, are largely individualistic, and their expression may frequently get an individual into trouble with the herd. Instinct alone is not, in a modern human society, even an adequate guide for the conduct of domesticated cats and dogs,—much less for the human members of the community. Yet a certain school of self-styled advanced thinkers looks to it as a guide in problems of conduct, urging that obedience to instinct is the duty and privilege of the "free man." Unless this view is seriously qualified, it is hardly necessary to say that it is at least 10,000 years behind the times.

2. *Custom.* The lines of conduct evolved as the result of conflict and compromise between selfish instinct and the requirements of co-operative social life steadily increasing in complexity, have led to the establishment of mores, folkways, written or unwritten laws,

[1] Address before the Section on Delinquency, California Conference of Social Work, San Diego, April 26, 1922.

customs, which have been held up as the pattern for the conduct of the individual. In many primitive communities these are almost inexorable; and even yet, in the highest civilization of the present day, they are perhaps more important than any other one factor, in the code of morality.

3. *Revelation*. These customs were in almost all societies backed up, reinforced, and supplemented by revelation of a supposed divine standard of conduct, handed down from above by some superhuman power. Such revelation, whether it be the Ten Commandments, the Koran, or the sacred writings of any other people, has for long periods been accepted as an unquestionable rule for guidance, and is to a large extent so accepted at the present day. The authority of revelation is rapidly breaking down, however, for reasons that need not here be rehearsed; moreover, most of the extant revelations are of some antiquity, and not always easy of application to modern problems.

THE CONSCIENTIOUS MAN

4. *Conscience* is relied upon by many as a supplement to or replacement of the preceding factors. Of all injunctions for the guidance of conduct, the exhortation to "obey the dictates of your own conscience" is perhaps the worst; for "conscience" is often but a vague and mystical name for the collection of prejudices and unrecognized complexes that exist in the human mind, and action upon it is no safe basis for successful adjustment. Frequently the conscientious ideas are the results of internal, mental conflicts: they are merely expressions of the individual's more or less unsuccessful attempt to solve some of his pressing problems. For illustration, I take the case of the so-called conscientious objectors in the Great War. I am not referring to those who had a "streak of yellow," and grasped at any straw to evade military service; nor to those who honestly believed—for reasons unacceptable to their fellow-citizens—that the United States was on the wrong side of the conflict. I am speaking of the genuine pacifist, who felt willing to suffer any indignity rather than to take up arms and shed the blood of his fellow-men. For the present purpose, it makes no difference whether these men were ethically right or wrong: I am merely describing the mechanism of belief. These martyrs—at least, those of them who were sent to the penitentiary—were found by mental test to be far above the average in intelligence.[2] What did their conscience on this point amount to? Different things in different cases, of course; but in many instances it showed nothing more than that its exponent had had domestic infelicities—or, to put it more crudely, a nagging wife. The mind unconsciously set up a defense against an unbearable domestic situation, in a strong feeling of the wrongfulness of conflict of any kind, and a strong demand for peace at any price. A man who, because he has been henpecked, develops beliefs that make him willing to go to the penitentiary rather than to share in the glory conferred by popular excitement on the participants in a "war to end war," is a proper subject for sympathetic and scientific understanding; but it is quite out of the question for his fellow-citizens to venerate his emotional attitude as a form of superior and divinely-inspired guidance in the most important affairs of life. Conscience, which might in many cases be more correctly termed "unconscience," is not a dependable counselor.

THE APPLICATION OF INTELLIGENCE

5. *Analysis*. The last type of standard for conduct, or basis for morality, to which I shall refer, is analysis based on an intelligent appreciation of the probable consequences of an act.

[2] *Memoirs of National Academy of Sciences*, Vol. xv, "Psychological Examining in the U. S. Army," ed. by R. M. Yerkes, Washington, 1921, p. 802 ff. Objectors of the political type were markedly more intelligent than those of the religious type, but both were far above the average of the draft.

It goes without saying that no complicated action of an individual is determined by only one of these factors. Ordinarily, no doubt, all five of them, and others, enter in to decide the resultant behavior. But as one or another will predominate, or be consciously emphasized, I think the classification I have just given is legitimate for my present purpose.

Now, out of this complicated make-up of "morality," where is any solid ground to be found, on which the socially-minded individual can take a stand?

Instinct is unsafe, for an act based on impulse is quite as likely to be immoral as to be moral. The social evolution of man has progressed, in the last million years, so much faster and farther than the evolution of his inherent make-up, that he has far outgrown, so to speak, his native equipment, which in many cases, in civilized society, is more harmful than helpful.

Custom is valuable to a certain extent, as embodying part of the experience of the race. On the other hand, it is bound always to lag a little behind progress, which leads the young and impetuous to scoff, sometimes justifiably, at the restraints of "conventionality" as old-fashioned. Moreover, custom has varied so widely, the moral act in one nation or period being disgusting or outrageous in another, that custom has no great claim to sanctity. Our own forefathers not long ago thought it a sacred duty—or perhaps privilege—to murder those who differed from them on questions of dogmatic theology; while peoples with a rather high type of culture have considered it moral to put to death their own infants, to steal, to support prostitution as part of their religion, and to practice almost all the other crimes and vices of which a conference on social work can take cognizance.

Divine revelation is no longer a sufficient guide for many thoughtful people.

Conscience, for such reasons as I indicated above, is but a will-of-the-wisp.

THE PLACE FOR INTELLIGENCE

It is obvious, I think, that only in intelligent analysis of a situation is to be found any sound basis for morality. I do not wish to be thought to overrate the possibilities of intelligence. The human mind, at best, is a feeble and imperfect instrument. Even when provided with the best of principles, it too often goes wholly astray. The reasoning powers of the mind are all too often devoted solely to inventing a plausible justification for what the so-called instincts have already led their possessor to do. It is of primary importance that the intelligence, such as it is, have sound principles on which to act. Of the many bases from which philosophers have tried to derive a rational morality,[3] but one stands, in the last analysis, as unimpeachable. The survival, and improvement, of the race or group, is the one end to which others must, if necessary, be subordinate. Conduct which leads to the deterioration, or extinction, of the group which practises it, can only be considered evil conduct. A good, righteous, worthy, or social act must, therefore, be one that tends to favor the survival of the group or race. Here, it seems to me, is the sound basis for morality; and I therefore accept, as the most useful of the various conceptions current, the definition of morality as

[3] The types of moral theory may be classified as absolute and relative. The first type, exemplified by the doctrines of Immanuel Kant, supposes that there are certain "eternal and immutable" principles of conduct (which, in the opinion of most of the absolutist philosophers, are intuitively perceived). The relativists measure the value of an act by its consequences. The best-advertised of the relativistic theories is Utilitarianism, expounded enthusiastically by Jeremy Bentham, John Stuart Mill, and many other able men a century or less ago, with "the greatest happiness of the greatest number" as a campaign cry.

Or types of moral theory may be classed as intuitional and empirical. The former listens for the guidance of an "inward monitor" or "still, small voice"; the latter bases its judgments on the experience of how an act "works."

The theory which I am here upholding is of course to be classed as relativistic and empirical.

conduct that tends toward the progressive evolution of the human species.

In the light of this definition it is clear that, theoretically at least, there can be no such thing as unmoral, in the sense in which the word is currently used. Some acts, indeed, may have no appreciable bearing on morality, one way or the other; but they are less numerous than one might suppose at first thought. Usually the balance must fall on one side or the other. One often hears a person (usually, as it happens, a person of immoral conduct) apologetically described as "simply unmoral." This is absurd. The person may not have sense enough to know whether his or her acts are moral or the reverse; but either moral or immoral they must certainly be.

PREDICTING THE CONSEQUENCES

As to whether a given act is in effect moral or immoral, the consequences obviously must decide. These naturally can not actually be seen in advance; there are, therefore, two ways of determining whether an act is moral or immoral:

(1) Retrospection, to see how similar acts under similar conditions have resulted in the past. The "verdict of history" is to some extent crystallized in the mores or "conventional morality" of a people, but at best, as I pointed out, this is useful only to a limited extent, because conditions are always changing.

(2) Analysis, by which in imagination one deduces what the consequences of an act are likely to be. This is, of course, possible only to a fairly high order of intelligence. But it also takes a good deal of intelligence to interpret correctly the lessons of history. Indeed, some pessimist has said, "the only lesson history can teach us is that it has no lesson to teach."

If my premises are sound, it follows that an individual who voluntarily and regularly lives morally, must be intelligent. Morality is from this point of view a function of intelligence. One may, of course, be led or forced into a straight path by others; but such an individual can not be expected to stay in the path any longer than he feels the pull of the halter-rope. Hence the morality most desirable must be admitted to be that which represents the reflective conduct of an intelligent population.

The point I desire particularly to make, then, is that so far as a man acts morally, and knows what he is doing—so far as he is a conscious and controlling agent of his own destiny—he must act intelligently;[4] he must be guided by his own reasoning ability applied to such data as he can collect, and to his own critical evaluation of the reasoning of other individuals on similar problems.

This close relation between intelligence and morality is not merely a matter of logic, but of observed evidence. Statistical researches such as that of Frederick Adams Woods[5] have shown it to be a fact that intelligence and morality go hand in hand. That immorality and lack of intelligence also go hand in hand can be observed by any who studies delinquency. The dependence of these two conditions on each other is capable of more or less precise measurement, so that to a marked extent a man's intelligence can be predicted by measuring the morality of his conduct, and vice versa.

INTELLIGENCE THE KEY

Good conduct is usually thought of as the product of at least three factors:

[4] I do not wish to be understood as attributing to "reason" what it can not accomplish. Action must be the outcome of feeling rather than reason; and the emotions, impulses, and urges, which are, too often, almost independent of reason, are in many connections of paramount importance. Brevity compels me to omit any consideration of them here. In any case—to speak figuratively—it is reason which must decide a disputed point, even though the decision of reason must be carried into effect through some driving power in the mind. Moreover, there is in any community plenty of emotion to meet all requirements. It is reason that is most often lacking, and which I have therefore chosen to emphasize on this occasion.

[5] Woods, Frederick Adams, *Mental and Moral Heredity in Royalty*, New York, 1906. See also Popenoe, Paul, "Will Morality Disappear?", JOURNAL OF HEREDITY, ix, p. 269, Oct., 1918.

intelligence, emotional control, and environment. This offers no contradiction, for these qualities are positively correlated with each other. Though many individual exceptions will come to mind, it may be taken as certain that on the average the more intelligent man will be more able to control, not only his emotions, but also his environment. It is fair, therefore, to pick out intelligence as the key.

Now if anything is well demonstrated, it is that intelligence depends primarily on heredity: that unless one is born to become intelligent one can never become so. Education is, of course, necessary, but something to educate is a prerequisite. Fundamentally, the only way in which the United States as a nation can attain to a higher permanent level of morality, is to contain more intelligent people. And the only way of reaching this condition is by such changes in the birth-rates of different parts of the population as will make the most intelligent families produce more children, and the mentally defective stop reproducing—in a word, by eugenics.

RYE-WHEAT AND WHEAT-RYE HYBRIDS[1]

E. F. Gaines
AND
F. J. Stevenson
State College of Washington

CROSSES between wheat and rye are rare and difficult to make owing to the tendency to come sterile but after seven years' work at the Washington Agricultural Experiment Station reciprocal crosses of these two species have been obtained. This marks a new step in plant breeding work, as a cross in which rye was used as the mother parent has never been reported so far as the writers are aware. Several crosses between wheat and rye in which wheat was used as the female parent have been obtained by other investigators. Leighty[2] reports the work done by Carman about 1880, by which several crosses of wheat and rye were secured. All of these possessed a high degree of sterility and in the words of Carman, "The trial finally came to an end on account of the absolute barrenness of the latest progeny." Leighty also reports[3] the occurrence of several natural wheat-rye hybrids which were found at the Arlington Station and elsewhere. These resembled wheat in their general appearance but were intermediate to wheat and rye in such characters as head length, pubescence of peduncle, size of culm, thickness of culm, density of the pith, and shape and size of glumes.

McFadden[4] reports the production of two wheat-rye hybrids which were wheat-like in appearance and sterile to a high degree. Backhouse[5] states that wheat-rye hybrids can be obtained more readily with some varieties of wheat than with others and that "crossability" is heritable in the varieties

[1] Contribution from the Agricultural Experiment Station, State College of Washington, Pullman, Washington.

[2] Leighty, Clyde E. 1916. Carman's wheat-rye hybrids. Journal of Heredity *7:* 420-427.

[3] ———— 1920. Natural wheat-rye hybrids of 1918. Journal of Heredity *11:* 129-136.

[4] McFadden, E. A. 1917. Wheat-rye hybrids. Journal of Heredity *8:* 335-336.

[5] Backhouse, W. O. 1916. Note on the inheritance of "crossability." *Journal of Genetics 6:* 91-94.

studied. Love and Craig[6] report a number of wheat-rye crosses most of which were completely sterile in the F_1. They discuss, however, a wheat-rye hybrid which gave one seed in each of the F_1 and F_2 generations. The F_3 plant was more wheat-like than the F_1 or F_2 and did not show its hybrid nature to any great extent. It produced many seeds from which an F_4 generation was grown. The plants of this F_4 family were variable and seemed to segregate according to a simple Mendelian ratio of 3:1 with respect to color of chaff, beards and color of kernel. A difference in sterility was also exhibited in this generation, some of the plants being completely fertile and some nearly sterile. The F_2 plant was bearded. The F_3 plant was not illustrated, but the authors state that it was more wheat-like than either the F_1 or the F_2 plants. The bearded habit in cereals is generally recessive. The F_3 and later families should, therefore, have all been bearded like the F_2 plant, but in the illustrations, approximately three-fourths of the F_4 plants were beardless. If the lone seed which was produced by the F_2 plant had been the result of cross-fertilization with wheat, the result in the F_4 generation would be expected. The increased fertility of the F_3 plant also adds weight to the supposition that a natural or accidental back cross with wheat might have occurred in the F_2, to produce the wheat-like F_3 plant.

Besides the American investigators mentioned above much work has been done by European plant breeders in attempting crosses between wheat and rye, but with the same general type of results.

HYBRIDS MADE AT PULLMAN, WASH.

The work with wheat-rye hybrids at the Washington Agricultural Experiment Station was begun in 1915 but no fertile F_1 plants were obtained until Rosen was used as the rye parent in 1919. This rye was introduced into Michigan from Russia in 1909. It is so prolific that Spragg[7] reports that it has crowded out wheat in certain sections of Michigan. It is more compatible with wheat than any other rye worked with at this station, and is unique in that partly fertile F_1 plants were obtained when it was used either as male or female parent. During the first four years various rye crosses were tried with different wheats and even barley and rye crosses were attempted. A number of seeds were obtained but most of them did not grow. The few that did grow were fully fertile and exactly like the female parent, the flowers apparently having been selfed in the operation of hybridizing. With Rosen rye it was different. Seven crosses made with this rye produced 44 seeds from which only 8 plants were obtained that showed unmistakably their hybrid origin, that is, they were intermediate. Four of these crosses were rye-wheat, that is, rye was the female parent, and three were wheat-rye, that is, wheat was the female parent.

FIRST GENERATION OF RYE-WHEAT HYBRIDS

The four rye-wheat hybrids were obtained with Rosen as the female

TABLE 1. *Showing the number of flowers treated, number of seeds set, number of F_1 plants and number of F_2 plants*

Name of hybrid	No. of flowers treated	No. of seeds set 1919	No. of F_1 plants 1920	No. of F_2 plants 1921
Rosen × Fortyfold	46	5	0	0
Rosen × Jenkin	22	10	1	7
Rosen × Jones Fife	22	8	1	27
Rosen × Hybrid 128	18	13	4	143

[6] Love, H. H. and Craig, W. T. 1919. Fertile wheat-rye hybrids. JOURNAL OF HEREDITY *10*: 195-207.

[7] Spragg, Frank A. 1921. Rosen Rye. Michigan Agr. Exp. Sta. Special Bulletin 105: 1-11.

PARENTS AND SECOND GENERATION OF WHEAT-RYE HYBRIDS

The resemblance to the female parent, Rosen rye (1) is evident. The male parent, Hybrid 128 (4) is extremely susceptible to bunt, while rye is nearly immune. The hybrid plants were sometimes affected, and (3) shows a bunted head of the hybrid. In view of the finding of completely bunted heads of rye this does not necessarily indicate the inheritance of a male characteristic. (Fig. 17.)

parent and four wheat varieties Forty-fold, Jenkin, Jones Fife and Hybrid 128 as male parents. Table 1 gives the performance data for all four of these hybrids for the years 1919, 1920, and 1921.

A comparatively high percentage of the flowers treated set seed but very few of these produced F_1 plants. The five seeds of Rosen × Fortyfold resembled rye in general appearance but were badly shrunken and all failed to produce F_1 plants. The taxonomic characters of the F_1 plant of Rosen × Jenkin were very much like those of rye but were slightly modified by the wheat parent. It was evident from these modified characters and from the 95 percent sterility displayed that this was a true F_1 plant. The same might be said of the appearance of the F_1 plant secured from Rosen × Jones Fife but this was slightly more fertile. Four F_1 plants of Rosen × Hybrid 128 were also secured. These again did not differ greatly from rye in their botanical characters but they all exhibited a high degree of sterility which varied with the individual from 75 percent for the most fertile one to 90 percent for the one highest in sterility.

SECOND GENERATION OF RYE-WHEAT HYBRIDS

The character which showed the greatest variation in the F_2 was the degree of fertility. This ranged from complete sterility to complete fertility with an average of 50 percent. The average fertility is much greater than that shown in the F_1 generation, as the F_1 plants were all in class 1. (See below.)

The data on fertility are shown in table 2 which gives the distribution of the differing characteristics of the parent plants and their F_2 hybrids. The method of obtaining the data was as follows: the plants were pulled and brought into the laboratory where an estimate of the fertility was made by passing the heads of each plant through the fingers. After a little practice one can readily tell whether the floral glume contains a seed or is sterile. The plants were arbitrarily thrown into five classes. Class 4 represents as complete fertility as is normally found in wheat, class 0 represents complete sterility and classes 1, 2 and 3 represent degrees of fertility approaching one-fourth, one-half and three-fourths respectively. With the exception of the wide variation in fertility the F_2 plants

TABLE 2. *Distribution of the differing characteristics of the parent plants and their F_2 hybrids in the rye-wheat crosses*

Number		Number plants analyzed	Plant height av. cms.	Head length av. cms.	Purple straw percent	Pubescent peduncle percent	Hollow culm percent	Fertility (a) No. plants in each class				
								0	1	2	3	4
1940	Rosen rye	41	137	11.7	0	66	15	0	0	10	19	12
526	Jenkin	(b)	109	5.1	0	0	100	0	0	0	0	A11
371	Jones Fife	(c)	99	10.9	0	0	100	0	0	0	0	A11
592	Hybrid 128	(c)	104	4.6	0	0	100	0	0	0	0	A11
3905	Rosen × Jenkin	7	124		0	57			(d)	(d)		
3915	Rosen × Jones Fife	20	127	11.2	90	60			"	"		
3911	Rosen × Hybrid 128	70	114			46			"	"		
3912	"	15	112	9.4		67	27	1	5	2	5	2
3913	"	19	119	10.9	37	68	21	1	6	8	3	1
3914	"	20	122	10.9	15	70	55	1	4	4	8	3

(a) The degree of fertility was arbitrarily divided into five classes, class 4 represents as complete fertility as is normally found in wheat, class 0 represents complete sterility, and classes 1, 2 and 3 represent a degree of fertility approaching one-fourth, one-half and three-fourths.

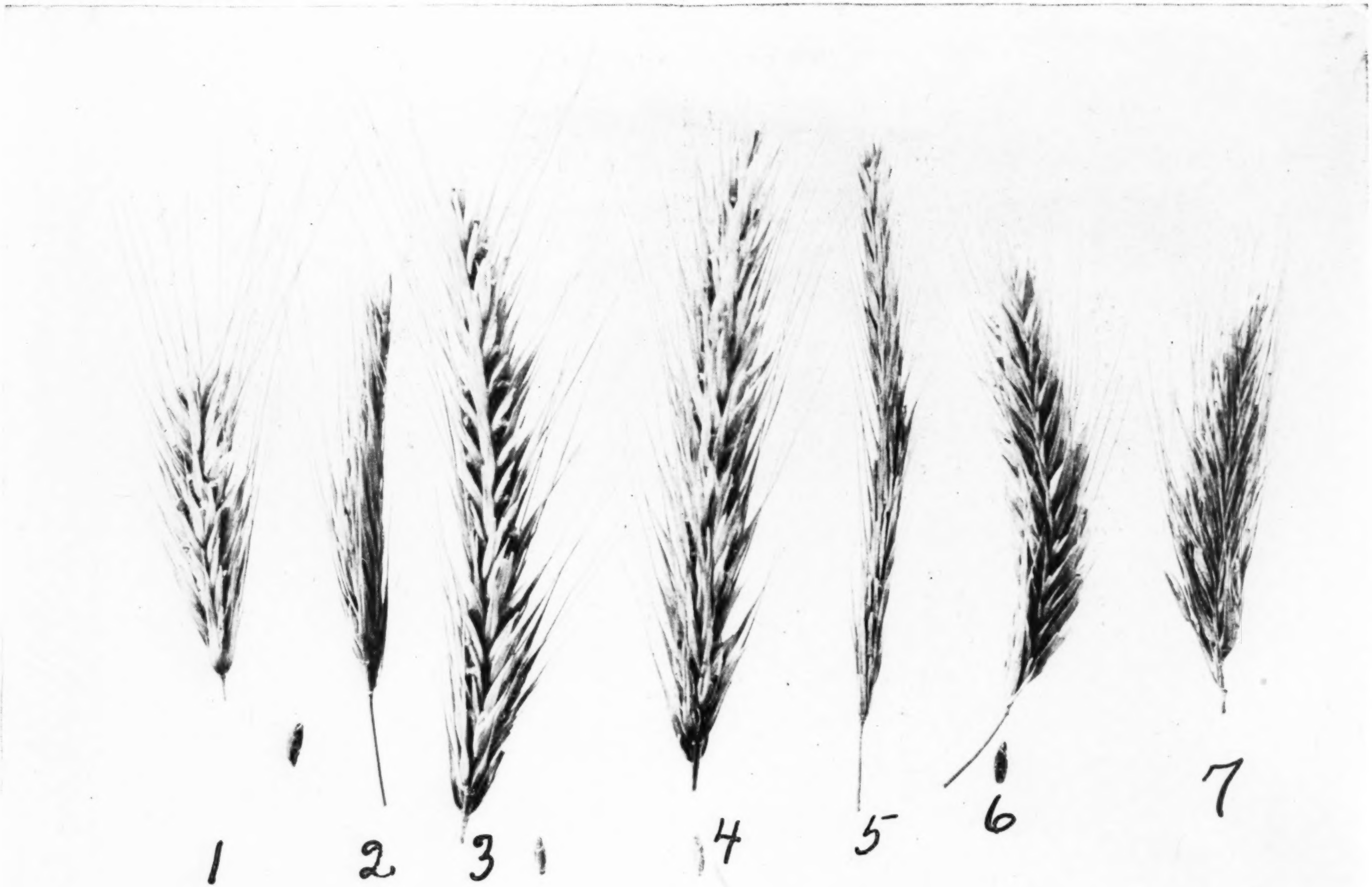
(b) 3 year average.

(c) 10 year average.

(d) No record.

PARENTS AND SECOND GENERATION OF WHEAT-RYE HYBRIDS

Turkey wheat (1) and Rosen rye (4) with the hybrid forms between. Both parents are very resistant to bunt, and both are bearded. The hybrid heads are beardless and one of them (2) is bunted. (Fig. 18.)



SECOND GENERATION HYBRID RYE-WHEAT TYPES

The dominance of the maternal parent is evident. Hybridization in this case has resulted in a high degree of sterility. Carman's original experiments with this cross were brought to a close "on account of the absolute barrenness of the latest progeny." (Fig. 19)

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TYPES OF WHEAT-RYE HYBRIDS

All wheat-like in appearance. Some of the other characters were intermediate, but one almost questions whether these are crosses in the usual sense of the word, or whether the male element may not have initiated development without conjugation. In generic crosses the genetic mechanism of the cell is often seriously upset in a way that is not very well understood. (Fig. 20.)

were very rye-like, especially with respect to such characters as beards, ciliation and shape of the lemmas. They were bearded in spite of the fact that all the wheat parents were beardless, but the beards in some cases were much shorter than those on rye. The lemmas were all lanceolate in shape and possessed distinct ciliate keels with the exception of five plants in the cross with Hybrid 128 which showed a slight modification in this character, as they were ciliate only toward the tips.

The fourth column of table 2 shows that the average plant height of each cross is intermediate to its parents. The low extreme approximates wheat and the upper extreme approximates rye in height. The average head length of the four F_2 families analyzed is shorter than rye but longer than the wheat parent in each case. The heads of family number 3912 averaged one and one-half centimeters shorter than its three sibs. Its shortest heads were but little longer than the longest heads of Hybrid 128. The striking contrast in head length is shown in figure 17 which represents a head of each of the parents with two of the F_2 segregates between. This shows the rye (female) to be nearly three times as long as the wheat (male). The F_2 types are intermediate in length. The one to the right is infected with *Tilletia tritici*. The extremes in head length and fertility are illustrated in figure 19.

Ninety percent of the F_2 plants of Rosen × Jones Fife had purple straw although the wheat and rye that went into the cross both have white straw with no indication of purpling in leaf-sheath or internode. The appearance of color evidently comes from the unusual recombinations of rye and wheat chromatin. This purpling of the straw, especially in the upper internode also appeared to a less degree among the F_2 plants of Rosen × Hybrid 128. No purpling appeared in the F_2 family of Rosen × Jenkin.

Number 3911 gave 46 percent of plants with pubescent peduncles which is lower than that found in the rye parent but the percentage in all the other families was very similar to the variation in Rosen. In the F_2 families of Rosen × Hybrid 128 a higher percentage of hollow culms was found than in the rye parent.

The plants in number 3914 not only contained hollow culms up to the base of the heads in more than one-half of the plants, but the neck immediately below the head was thicker and stiffer and more like that of wheat. None of these segregations give a simple unit character ratio but the variations show a recombination of the characters of wheat and rye with those of the female parent predominating.

FIRST GENERATION OF WHEAT-RYE HYBRIDS

Maternal dominance is shown again in the wheat-rye hybrids. The general appearance of the two F_1 plants of Turkey × Rosen was very much like that of wheat, but they could be readily distinguished as true F_1 plants by the high degree of sterility. One plant produced 24 completely sterile heads and 6 that were partly sterile, the other produced 13 sterile and 10 partly sterile heads.

SECOND GENERATION OF WHEAT-RYE HYBRIDS

That the chromatin material was disarranged when the recombination took place is shown by the plant characters in the F_2 generation. Nine of the 15 plants were beardless although Turkey and Rosen are both bearded. The wheat chromosome carrying the gene for beards might have been eliminated in the first hybrid seed. The rye gene for beards recombining in the F_1 generation would then produce beardless and bearded plants in the F_2 in the ratio 3:1. This hypothesis could also be used to explain the unusual results obtained by Love and Craig.

Hybridization under normal conditions increases fertility but in this cross only one plant showed normal fertility. Two others were 50 percent sterile, two 75 percent, six from 90 to 98 percent and three completely sterile.

Each of the characters, pubescent peduncle and solid culm, seemed to be

inherited from the rye as a unit character, as the ratio for each is as close to 3:1 as could be expected with the small number of plants. The data for these characters are given in the following tabulation:

11 pubescent peduncles	4 glabrous peduncles
12 hollow culms	3 solid culms

Figure 18 shows Turkey and Rosen with two of the F_2 segregates between. Number 2 represents a head from a smutted plant and number 3 one of the partly sterile beardless types. Figure 20 shows a representative head from each of the F_2 types.

BUNT ON RYE

Bunt was found this past season on Common rye, on an F_2 plant of Rosen × Hybrid 128 and on an F_2 plant of Turkey × Rosen. It is a common pest in this country but its attacks were thought to be limited to the genus Triticum. The occurrence of a totally bunted plant in each of the F_2 generations seemed to indicate the genetic relationship of the parents, but when later in the season two totally bunted heads of common rye were discovered in the variety test plots this hypothesis did not seem quite so conclusive.

DISCUSSION AND SUMMARY

Generic crosses are fairly common in the literature and many show a considerable degree of fertility. Wheat and rye are considered on the borderland, representing the widest cross among cereals that may be made and yet recover fixed segregates in later generations. In fact, it is questionable whether truly intermediate segregates can be so obtained, for all the wheat-rye hybrids reported thus far have been decidedly wheat-like by the time they reached the homozygous conditions of their principal taxonomic characters. Similarly, the rye-wheat crosses reported herein are all rye-like in the F_2, and it may reasonably be supposed that the variations in subsequent generations will be in the direction of the maternal rye progenitor. Rosen rye seems so much more compatible in crossing with wheat than other varieties that the question arises as to whether it may not carry a different complement of chromosomes. We have been able to cross it with Jenkin, Hybrid 128 and Jones Fife wheat and to obtain F_1 plants that were not entirely sterile even when Rosen rye was the female parent. This is a feat never accomplished with any other rye at this station and is the first recorded instance of a rye-wheat cross insofar as the writers are aware. From the three crosses 7, 143 and 27, F_2 plants respectively were produced in the season of 1921. They were all rye-like in appearance resembling the maternal parent strongly, and a few of them exhibited as high a degree of fertility as Rosen rye.

One wheat-rye cross was obtained with Turkey wheat as the female parent and Rosen rye as the male parent. The Rosen pollen did not stamp the rye characteristics on the F_1, or F_2 progeny to any great extent, but the abnormality and barrenness of the plants showed a violent upsetting of normal metabolism. The four wheats used in the crosses with Rosen rye are all fertile inter se. The wheat-rye cross gave progeny which were all wheat-like. The rye-wheat crosses gave progeny that were all rye-like. Thus in every case only matroclinous hybrids were obtained. Although reciprocal crosses with the same wheat variety were not obtained, it seems, reasoning from analogy, that if such had been secured they would have been very different. This is very unusual and may have a cytological basis, for the wheats according to Sax[8] have 21 chromosomes (haploid) and Rosen probably has 7.

Turkey is very resistant to bunt, seldom producing more than five percent of bunted heads even when the seed is blackened with viable spores. The occurrence of a completely bunted plant in the F_2 generation of Turkey × Rosen, therefore, came as a surprise for it would scarcely have been expected

[8] Sax, Karl. 1921. Chromosome relationships in wheat. Science N. S. *54:* 413-415.

in the wheat parent, much less on rye. It has often been noticed that certain segregates in wide crosses of different species of wheat are much more predisposed to stem rust and yellow rust than the parents.

One plant in the F_2 of Rosen × Hybrid 128 was also found to be infected but since the Hybrid 128 parent is very susceptible to bunt, infected plants might be expected in this cross.

Whether any new strain of commercial value can be developed from very wide crosses is a debatable question. To the writers such crosses seem freighted with possibilities. If, however, matroclinous hybrids are the rule the variation in form might be limited, but in the final recombinations of compatible chromatin new forms unlike anything ever seen before are possible. In the creation of the new, might not a form appear more desirable for the purposes of man than anything now in existence?

A NEW SPECIES OF MAN FROM AFRICA

While the anti-evolution propaganda grows in the southern states ardently championed by an ex-Secretary of State, the fossil bones of a new member of the human species have been uncovered in Rhodesia. This new find has been the occasion of some discussion as to its antiquity and the salient features are ably presented in the *Atlantic Monthly* by Dr. G. Elliot Smith.[1] The bones are heavily encrusted with salts of zinc and lead but are not mineralized or strictly fossilized. They were found at the Broken Hill Mine in northern Rhodesia, about 300 miles north of Zambezi, and constitute the first important discovery of prehistoric man in the African continent. This new member of the human family has been designated *Homo rhodesiensis* and takes its place with *H. neanderthalensis* and *H. heidelbergensis* in the evolutionary ladder of *H. sapiens*, occupying a position in development intermediate between *H. neanderthalensis*, the lowest member of the genus Homo hitherto recognized, and *Eoanthropus dawsoni* and *Pithecanthropus erectus* the two most primitive forms of the human family, so primitive in fact that many palaeontologists still regard *Pithecanthropus* as an ape and the jaw of *Eoanthropus* as that of a chimpanzee. The form of the brain-case and the peculiarly distinctive features of the brain that it once contained leads Dr. Smith to believe that this Rhodesian species is the most primitive member of the genus Homo at present known, but not the most primitive of the human family.

He calls attention to the fact that even the lowly *Pithecanthropus* possessed the power of articulate speech which had reached an even higher stage of development in *Eoanthropus* while *H. rhodesiensis* lies between *Eoanthropus* and *H. neanderthalensis* in this respect.

There is still a question as to whether the Rhodesian man walked upright instead of with the bent-kneed locomotion of the Neanderthal man and, if so, how he can be considered more primitive than the latter, but Dr. Smith directs attention to the fact that *Pithecanthropus* walked erect though admittedly the most ancient and primitive member of the human family.

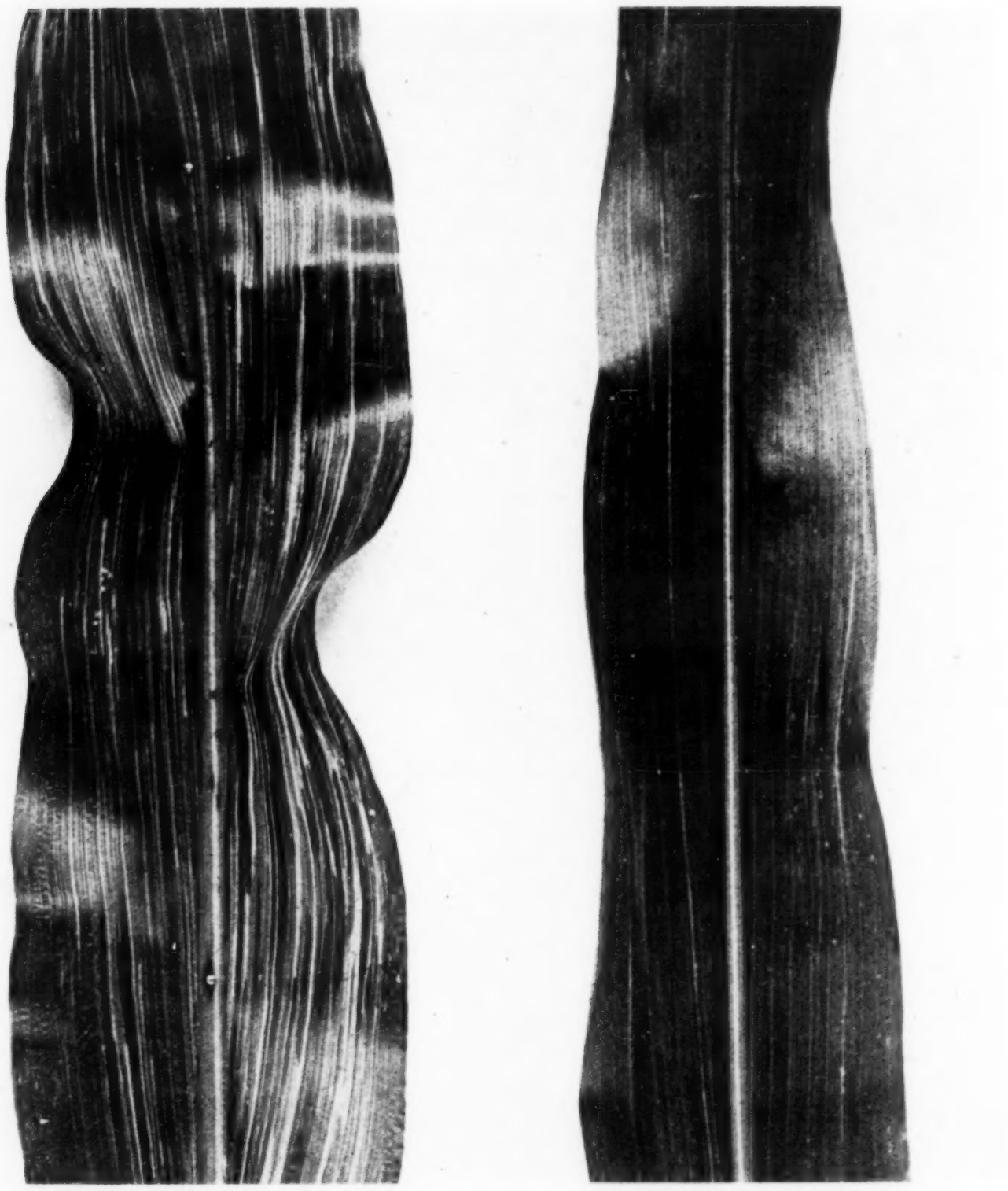
He is careful to state that while the evidence may favor the hypothesis that *H. rhodesiensis* walked erect it cannot be concluded from this that Rhodesian man was post-Neanderthal since even *H. sapiens* possesses some features more primitive than those of Neanderthal man.—J. H. K.

[1] Smith, G. Elliot. The Fossil Man of Rhodesia. *Atlantic Monthly*, pp. 454-465, April 1922.

HERITABLE CHARACTERS OF MAIZE

XI. FINE-STREAKED LEAVES[1]

E. G. ANDERSON



FINE-STREAKED MAIZE LEAVES

These leaves are characterized by a few fine white streaks as shown on the left, although occasional plants are found in which the streaks are more frequent and more prominent. Apparently the inheritance of this character is closely linked with the factor for the inheritance of white endosperm as no streaked plants were produced from yellow seeds. (Fig. 21.)

IN A NUMBER of cultures of maize grown in 1917, plants were found with finely streaked leaves. Records showed these cultures to be closely related. A few fine-streak plants were selfed and found to breed true. Outcrosses with unrelated normal green plants gave only normal green F_1 plants. Fine-streaked segregates were obtained in F_2, though usually less than 25 percent. These varied from prominently streaked to very faintly streaked or almost pure green plants. Backcrosses with fine-streak have likewise given less than 50 percent fine-streaks.

Fine-streak was first observed in cultures free from yellow endosperm. Crosses made involving yellow endosperm were backcrossed to the double recessive (white endosperm fine-streak). The yellow seeds when planted gave

[1] Paper No. 100, Department of Plant Breeding, Cornell University, Ithaca, New York.

FINE-STRIPED MAIZE LEAVES

They differ from the fine-streaked leaves shown in figure 22 in having the light streaks principally near the margins of the leaves. Crosses of this type with the fine streaked corn gave normal green plants in the first generation. (Fig. 22.)

about 100 plants, all normal green, whereas the white seeds gave a large number of fine-streaks. From similar backcrosses made later, 253 normal green plants were grown from yellow seeds, no fine streaks being obtained. The character "fine-streak" seems to be dependent upon a factor closely linked with the factor pair *Y y* for yellow *vs.* white endosperm. The failure to obtain more than about 50 percent of fine-streaks from the white seeds of the backcross may be due to a second factor necessary for fine-streak or may be due to the difficulty of distinguishing the fine-streak character from normal green.

Fine-streaked plants are characterized by narrow light streaks on the leaf blades. Usually only a few faint streaks are to be found, but occasionally plants are found with prominently streaked leaves (Fig. 21). There is some resemblance to the lineate leaved type described by Collins and Kempton,[2] but the light streaks are much fewer, coarser, and irregularly placed. It differs from Lindstrom's[3] fine-striped type (Fig. 22) in having the light streaks scattered throughout the leaves instead of being largely concentrated near the margins. Crosses of fine-streaked with fine-striped gave normal green F_1 plants.

[2] Collins, G. N. and Kempton, J. H. Heritable Characters of Maize: Lineate Leaves. Jour. Heredity 11: 3-6, 1920.

[3] Lindstrom, E. W. Chlorophyll Inheritance in Maize. Cornell Univ. Agr. Exp. Sta. Memoir 13: 1-68, 1918.

THE SCIENCE AND PRACTICAL APPLICATION OF EUGENICS

By Harry H. Laughlin
Eugenics Record Office
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I THE SCIENCE OF EUGENICS

THE essential idea of eugenics, that is, the conservation of specific family qualities, and the improvement of the hereditary endowments of a nation or race as a whole, by better breeding, is as old as civilization, both as an ideal and a practice; but the discovery and systematic coordination of the principles of biology and social organization which govern family and racial fortunes, is a relatively recent achievement. Within the last generation, scientific methods of observation, experimentation, tabulation and analysis have been applied to the family and racial fortunes of mankind, with the result that a definite and well systematized body of rules is being developed. Sir Francis Galton,[1] the centenary of whose birth is observed this year (1922), formulated the basic elements which justify calling eugenics a science. He applied the scientific method to his studies and was rewarded by finding that his analyses yielded not only demographic generalizations, but also biological principles. He is properly looked up to as the founder of the science.

Eugenics, like most other real things, existed before it was named. While preparing material for his first great work in eugenics, "Hereditary Genius," which appeared in 1869, Galton published his preliminary studies in this field in two papers in "Macmillan's Magazine" under the title "Hereditary Talent and Genius." They appeared in 1865—six years after his half-cousin,[2] Charles Darwin, had published "The Origin of Species." Although in Galton's earlier books and papers, the word 'eugenics' does not occur, these works constitute the first scientific publications on the subject. Galton continued his researches, and in 1883, in his book on "Inquiries into Human Faculty and Its Development," the word 'eugenics' appears (Second edition 1907, Reprint of 1911, p. 17) as the name of the systematized knowledge with which he had been working. In this book, Galton announces, as follows, the coinage of the word, and says concerning his research:

> "Its intention is to touch on various topics more or less connected with that of the cultivation of race, or, as we might call it, with 'eugenic' questions, and to present the results of several of my own separate investigations."

In this statement the word 'eugenic' is noted for reference at the foot of the page, where the following explanation appears:

> "That is, with questions bearing on what is termed in Greek, *eugenes*, namely, good in stock, hereditarily endowed with noble qualities. This, and the allied words, *eugenea*, etc., are equally applicable to men, brutes, and plants. We greatly want a brief word to express the science of improving stock, which is by no

[1] Francis Galton was born near Sparkbrook, Birmingham, England, February 16, 1822. He was graduated by Trinity College, Cambridge, in 1844, and received the knighthood in 1909. His death occurred at Haslemere, Surrey, January 17, 1911.

[2] Both Sir Francis Galton and Charles Darwin were grandsons of Dr. Erasmus Darwin (1731–1802), physician, poet, naturalist and philosopher. Charles Darwin was the son of Dr. Robert Darwin, whose mother was the first wife of Dr. Erasmus Darwin. Francis Galton was the son of Samuel Tertius Galton and F. A. Violetta Darwin, the latter a daughter of Dr. Erasmus Darwin by his second wife. To Francis Galton, the Darwin ancestral blood contributed a love of nature and of philosophic interpretation. As evidence, note that in 1794–6 the maternal grandfather, Erasmus Darwin, published "Zoonomia, or the Laws of Organic Life." From the Galton side came a love for statistical analysis. Both the father, Samuel Tertius Galton, and the grandfather, Samuel John Galton, were "scientists and statisticians by inclination." Galton suggests that the exceptional longevity that he, his brother and sisters and his mother enjoyed, came from "grandmother Darwin (1747–1832)," the second wife of Dr. Erasmus Darwin, who, before marriage to Dr. Darwin, was the widow of Colonel E. Sacheverel Chandos-Pole.

means confined to questions of judicious mating, but which, especially in the case of man, takes cognizance of all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had. The word *eugenics* would sufficiently express the idea; it is at least a neater word and a more generalized one than *viriculture*, which I once ventured to use."

Eugenics, like other sciences, draws heavily upon related bodies of knowledge and methods of study. While it seeks aid from allied sciences and is, in turn, called upon by them, its own special and borrowed knowledge is so systematized that it is entitled to a place of independent recognition. Indeed this independence on the one hand and this inter-dependence on the other is, paradoxical as it may seem, a characteristic of every science, no matter how highly specialized or how old it may be.

A reproduction of the certificate which was awarded by the President and the Committee on Exhibits of the Second International Congress of Eugenics to persons who exhibited eugenical material of merit at the Congress, appears on an accompanying page. The figure[3] at the top shows graphically the relation of eugenics to its allied sciences. It shows that particularly genetics, anthropology, statistics or demography, and genealogy and biography contribute great quantities of facts and principles to eugenics.

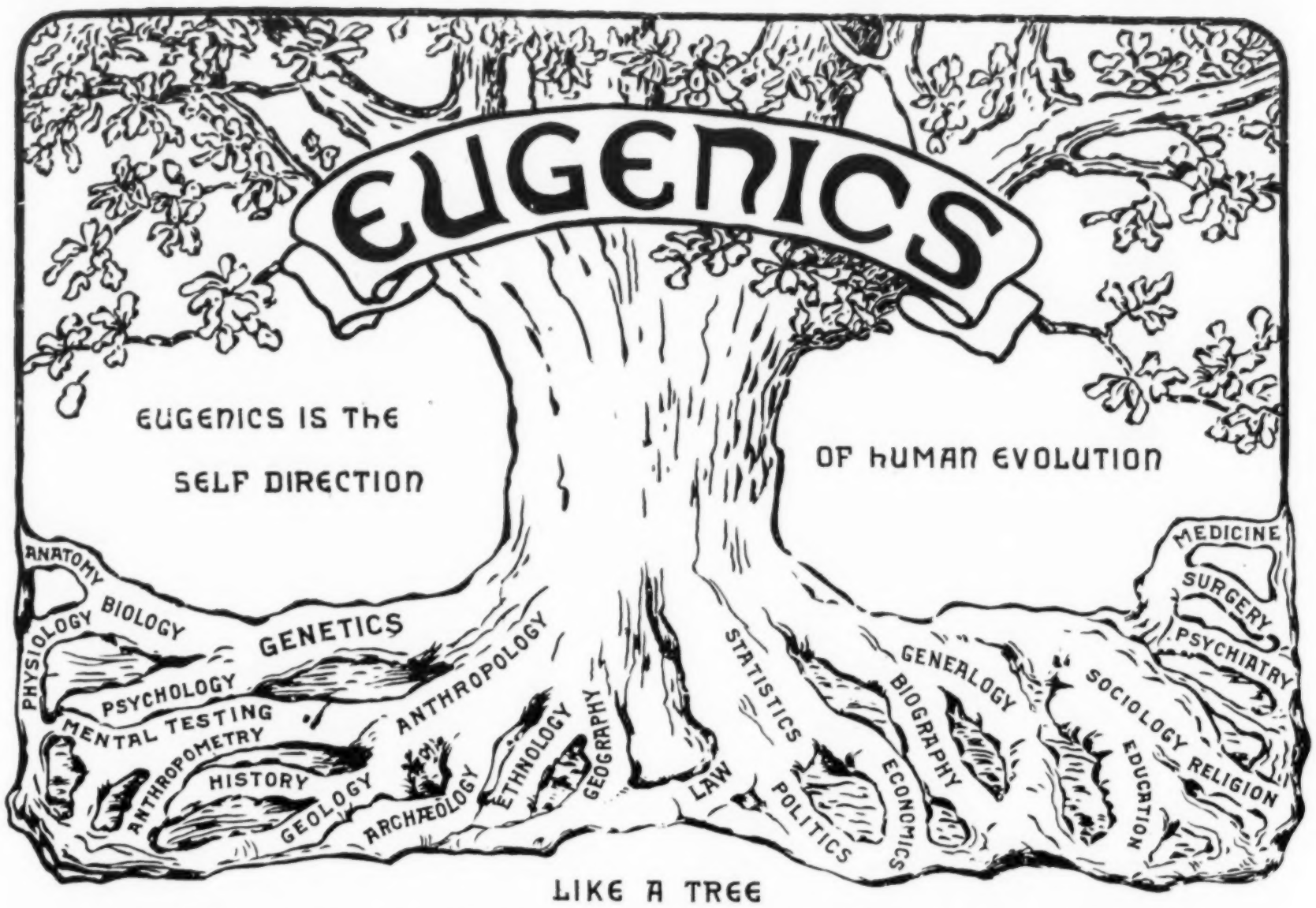
All metaphors have their limitations, but this one of the tree is correct to the extent of indicating that the substances drawn from the roots are reorganized and assimilated. It is improper to designate eugenics as subordinate to any one of its three or four principal contributory sciences, such as genetics or demography, or to any of the score of essential but less quantitatively contributing sciences. If, however, one were to construct a similar diagram showing education, statistics, genetics, history, medicine, psychiatry or other allied science or system as a tree, it would be necessary to show eugenics as constituting a root of considerable importance. This reminds us that all groups of knowledge are interwoven, and that each science secures its material from two sources, first, selectively from the whole mass of human knowledge and the known laws of nature, and second, by research into problems distinctively its own.

II THE PRACTICAL APPLICATION OF EUGENICS

Eugenics is the self-direction of human evolution. By its study, mankind seeks to find out the laws that govern the direction of human evolution. By its practical application, each of the several nations which constitute the species *Homo sapiens*, strives to direct its own evolution along those lines which seem to it most profitable. It is commonly agreed, for our own nation at least, that this family development of inborn traits must be along the lines, principally, of greater hardihood, longer period of individual efficiency, greater output of energy,[4] higher intellectual level, more highly specialized talents, finer social and moral adjustments, and with all a better natural balance of these qualities within the individual. The principal basis for confidence in eugenics as a practicable thing is derived from the success which mankind has had in directing the evolution of domestic races of plants and animals. Man is

[3] The plan of this diagram is the working out schematically of the substance of a paper on the "Relation of Eugenics to Other Sciences." (H. H. Laughlin, the *Eugenics Review*, London, July, 1919.) The drawing was made by Miss Alice M. Hellmer.

[4] Concerning human energy, Galton writes, "Energy is the capacity for labour. It is consistent with all the robust virtues, and makes a large practice of them possible. It is the measure of fulness of life; the more energy the more abundance of it; no energy at all is death; idiots are feeble and listless. . . . Energy is an attribute of the higher races, being favoured beyond all other qualities by natural selection. . . . In any scheme of eugenics, energy is the most important quality to favour; it is, as we have seen, the basis of living action, and it is eminently transmissible by descent." ("Inquiries into Human Faculty and Its Development," pp. 17, 18, 19. Second edition 1907, Reprint of 1911.)



LIKE A TREE
EUGENICS DRAWS ITS MATERIALS FROM MANY SOURCES AND ORGANIZES
THEM INTO AN HARMONIOUS ENTITY.

The Second International Congress of Eugenics, devoted to researches in all fields of science and practice which bear upon the improvement of racial qualities in man, convey this expression of appreciation of the display of a file of the

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which the American Genetic Association of Washington, D. C. has shown at the exhibition of the Congress at the American Museum of Natural History.

New York, September 1921.

Henry Fairfield Osborn
President of the Congress

Harry H. Laughlin.
Chairman of the Committee on Exhibits

an animal. The principal difference between plant and animal breeding and eugenics lies in the fact that the essential forces of race improvement—selective mating and elimination—which, in the one case, man applies to the lower species, in the other, he applies to himself.[5]

[5] Other differences between eugenics and breeding should not be overlooked. People not unnaturally resent and even oppose eugenics if they get the mistaken idea that eugenists are undertaking to control mankind as domestic animals are controlled. The chief object of plant and animal breeding is to produce large numbers of individuals as nearly alike as possible, by propagating from a single individual or a few select individuals, whereas eugenics relates to the general evolutionary improvement of the racial stock, with no idea of suppressing the normal individual diversity of talents, temperaments and physical features. Though the same general facts of inheritance, or "laws of heredity," must be taken into account in eugenics as in plant and animal breeding, the eugenic problems have to be worked out on entirely different lines. Racial progress will depend upon general information and education of the public to a state of eugenic consciousness and responsibility, which is not required for plant and animal breeding. For a statement at greater length, see "Eugenics and Breeding," by O. F. Cook in this JOURNAL, Vol. 5, pp. 30-33, January 1914.—Ed.

A New Catalog of Plant Names

All workers with plants should be greatly interested in a publication that has been announced recently by the American Joint Committee on Horticultural Nomenclature. The work is entitled the "Official Catalog of Standardized Plant Names" and will include:

(1) The approved Scientific Names of plants in American commerce, and the Synonyms which have been most generally used for such approved names; (2) The approved Common Names of such plants where such names have been formulated, and important synonymous or unapproved common names; (3) Authoritative lists of Variety Names, in important classes, such as Rose, Iris, Peony, Dahlia, Lilac, Rhododendron, Chrysanthemum, Sweet Peas, etc.; (4) The approved variety names of Fruits, according to the newly revised code of the American Pomological Society.

Confusion regarding the use of common and varietal names has been a very real obstacle to progress in plant physiology and genetics. Not a few of the discrepancies in the findings of plant investigators are traceable to unsuspected differences in the basic material used, different plants not infrequently being sold under the same varietal name and the same variety under different names.

The Official Catalog should go far toward effecting stability in the use of common names. The choice of names has been made very carefully and the committee in charge of the work represents the leading seed and nursery organizations as well as those interested in the more technical aspects of botany. There can be little doubt that the usages sanctioned in this work will be adopted generally by the trade.

There is a widespread feeling on the part of plant breeders that new plant productions should be protected by patent. A carefully prepared and complete list of existing varieties is the logical first step in this direction.

For complete information and prepublication prices those interested should address Harlan P. Kelsey, Sec'y American Joint Committee on Horticultural Nomenclature, Salem, Mass.

A REQUEST FOR MULTIPLE-LEAVED CLOVER PLANTS

H. F. Roberts, Professor of Botany of the University of Manitoba, Winnipeg, Canada, desires to obtain plants of White Dutch Clover (Trifolium repens) and Red Clover (Trifolium pratense) bearing supplementary leaflets. He desires a series having different numbers of leaves to use in a Genetics experiment. If readers of the JOURNAL OF HEREDITY who find such plants would be so kind as to mail them to Prof. Roberts, it would be greatly appreciated.